Evaluating Mixed and Augmented Reality:
A Systematic Literature Review (2009–2019)

SUPPLEMENTAL MATERIAL

Leonel Merino [ID]*   Magdalena Schwarzl†   Matthias Kraus‡   Michael Sedlmair [ID]§   Dieter Schmalstieg [ID]¶
University of Stuttgart   University of Stuttgart   University of Konstanz   University of Stuttgart   Graz University of Technology

Daniel Weiskopf [ID]‖
University of Stuttgart

Abstract

We present a systematic review of 458 papers that report on evaluations in mixed and augmented reality (MR/AR) published in ISMAR, CHI, IEEE VR, and UIST over a span of 11 years (2009–2019). Our goal is to provide guidance for future evaluations of MR/AR approaches. To this end, we characterize publications by paper type (*e.g.*, technique, design study), research topic (*e.g.*, tracking, rendering), evaluation scenario (*e.g.*, algorithm performance, user performance), cognitive aspects (*e.g.*, perception, emotion), and the context in which evaluations were conducted (*e.g.*, lab vs. in-the-wild). We found a strong coupling of types, topics, and scenarios. We observe two groups: (a) technology-centric performance evaluations of algorithms that focus on improving tracking, displays, reconstruction, rendering, and calibration, and (b) human-centric studies that analyze implications of applications and design, human factors on perception, usability, decision making, emotion, and attention. Amongst the 458 papers, we identified 248 user studies that involved 5,761 participants in total, of whom only 1,619 were identified as female. We identified 43 data collection methods used to analyze 10 cognitive aspects. We found nine objective methods, and eight methods that support qualitative analysis. A majority (216/248) of user studies are conducted in a laboratory setting. Often (138/248), such studies involve participants in a static way. However, we also found a fair number (30/248) of in-the-wild studies that involve participants in a mobile fashion. We consider this paper to be relevant to academia and industry alike in presenting the state-of-the-art and guiding the steps to designing, conducting, and analyzing results of evaluations in MR/AR.

Keywords: Mixed and Augmented Reality, Evaluation, Systematic Literature Review.

Index Terms: I.3.7 [Computing Methodologies]: Computer Graphics—Three-Dimensional Graphics and Realism; H.5.2 [Information Systems]: Information Interfaces and Presentation—User Interfaces; A.1 [General Literature]: Introductory and Survey—

CONTENTS

*e-mail: leonel.merino@visus.uni-stuttgart.de

†e-mail: magdalena.schwarzl@visus.uni-stuttgart.de

‡e-mail: matthias.kraus@uni-konstanz.de

§e-mail: michael.sedlmair@visus.uni-stuttgart.de

¶e-mail: schmalstieg@tugraz.at

‖e-mail: daniel.weiskopf@visus.uni-stuttgart.de

1 THE 458 PAPERS INCLUDED IN OUR STUDY

Venue	2019	2018	2017	2016	2015	2014	2013	2012	2011	2010	2009	Total
ISMAR	[12, 47, 53, 54, 64, 66, 88, 106, 146, 189, 190, 213, 223, 230, 241, 246, 257, 266, 290, 297, 347, 363, 364, 370, 376, 385, 387, 388, 397, 434, 435, 437]	[32, 36, 38, 55, 58,93,95, 130, 142, 147, 154, 155, 178, 179, 193, 211, 218, 240, 250, 265, 292, 308, 312, 321, 326, 329, 334, 338, 345, 404, 419, 430, 447]	[19, 30, 40,44,57, 72,82,87, 114, 118, 136, 163, 200, 227, 238, 248, 279, 311, 328, 337, 342, 360, 365, 383, 410, 416, 425, 427, 438, 456]	[2, 8, 14, 62, 103, 107, 134, 161, 170, 192, 205, 212, 247, 313, 323, 324, 333, 357, 361, 362, 415, 426, 442, 451]	[5, 31, 110, 135, 138, 185, 188, 222, 262, 276, 280, 286, 295, 317, 332, 336, 341, 380, 381, 392, 441, 448]	[25, 48, 51,65,73, 76,80,84, 109, 112, 127, 137, 160, 162, 169, 175, 180, 197, 198, 234, 242, 307, 325, 331, 335, 348, 359, 374, 391, 414, 453, 454]	[10, 33, 61, 75, 78, 94, 113, 115, 145, 187, 202, 225, 229, 237, 255, 261, 285, 300, 306, 314, 315, 373, 384, 390, 424, 439]	[15, 39, 56,79,90, 98, 100, 122, 139, 182, 186, 199, 219, 236, 271, 284, 302, 318, 344, 378, 401, 413, 432, 443, 445]	[4, 9, 28, 45,60,71, 116, 120, 133, 167, 181, 204, 224, 239, 260, 267, 273, 274, 291, 294, 305, 327, 366, 393, 458]	[17, 27, 29, 50, 85, 96, 99, 121, 141, 148, 150, 156, 166, 176, 196, 217, 231, 316, 319, 349, 382, 444, 452, 457]	[6,16,24, 49, 111, 119, 157, 164, 168, 173, 203, 214, 264, 270, 293, 301, 355, 358, 394, 396, 400, 407, 421]	**296**
CHI	[26, 35, 159, 165, 183, 201, 206, 232, 245, 252, 272, 310, 322, 353, 386, 402, 403, 406, 412, 436]	[22, 34, 105, 184, 194, 216, 259, 298, 309, 339, 405]	[41, 69, 83, 104, 126, 209, 226, 254, 289, 340, 356, 408, 450]	[21, 70, 92, 123, 153, 253, 268, 346]	[11, 102, 244, 277, 330, 395, 455]	[46, 117, 228, 235, 398, 417]	[13, 140, 296, 369]	[20, 108, 124, 149, 210, 275, 288, 371]	[220, 258, 399]	[367, 375, 428]	[63, 158, 171, 172, 420]	**88**
IEEE VR	[18, 43, 74, 129, 144, 151, 174, 177, 191, 243, 251, 256, 282, 343, 352, 354, 372, 379, 409, 433, 446]	[7, 42, 52,59,97, 249, 303, 411, 422, 423, 431]	[68]	[195]	[101, 132, 368]	[152]	[418]		[125, 283]	[81, 263, 299, 304]	[215]	**46**
UIST	[1, 91, 208, 320, 389, 440]	[37,128]	[67, 207, 221, 351, 449]	[131, 143, 281]	[269]	[23, 77, 86, 89, 233, 278, 377]	[3]	[350, 429]		[287]		**28**
Total	**79**	**57**	**49**	**36**	**33**	**46**	**32**	**35**	**30**	**32**	**29**	**458**

Table 1: The 458 papers included in our study.

2 TIME INDEPENDENT VISUALIZATIONS

2.1 Venues, Paper Types, Research Topics, Evaluation Scenarios, Cognitive Aspects, Study Configurations
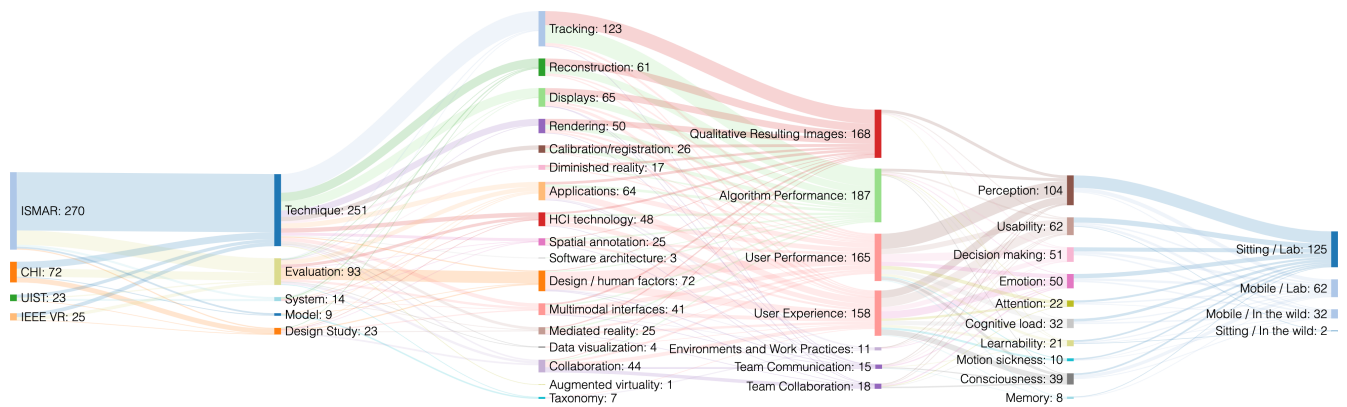

Figure 1: The 458 papers that report on evaluations in mixed and augmented reality (MR/AR) published in ISMAR, CHI, IEEE VR, and UIST between 2009 and 2019 classified by (left-to-right): venue, paper type, research topic, evaluation scenario, cognitive aspect involved in user studies, and study configuration (conducted in the lab or in-the-wild while participants were static or mobile.
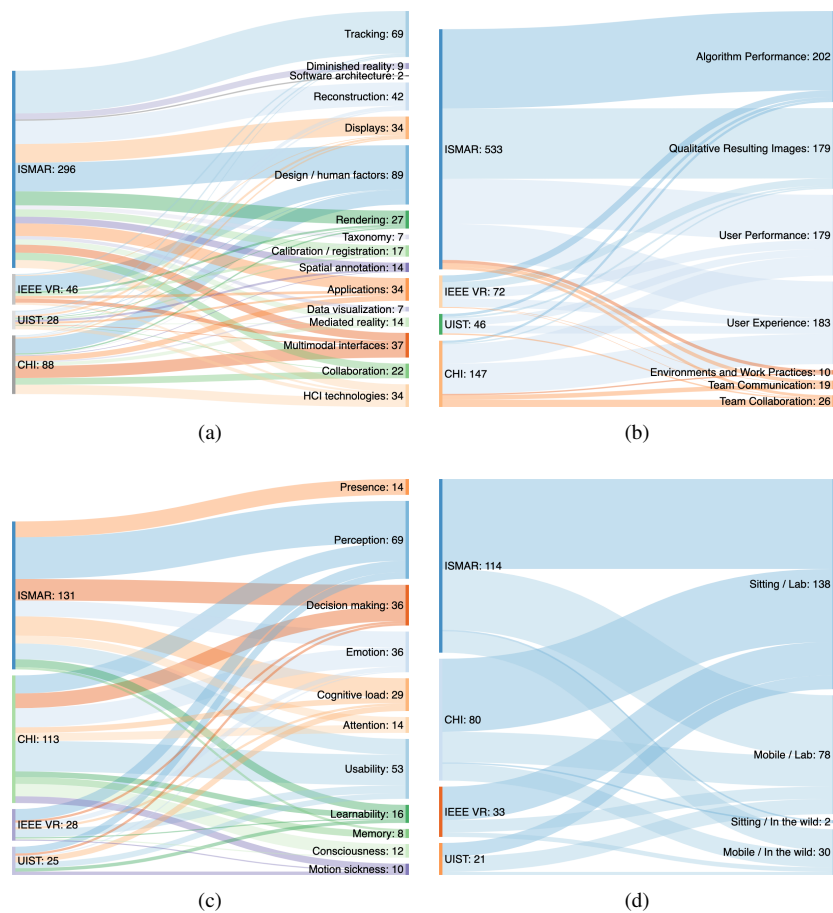

Figure 2: Topics of interests, evaluation scenarios, cognitive aspects, and configurations of user studies by venue.
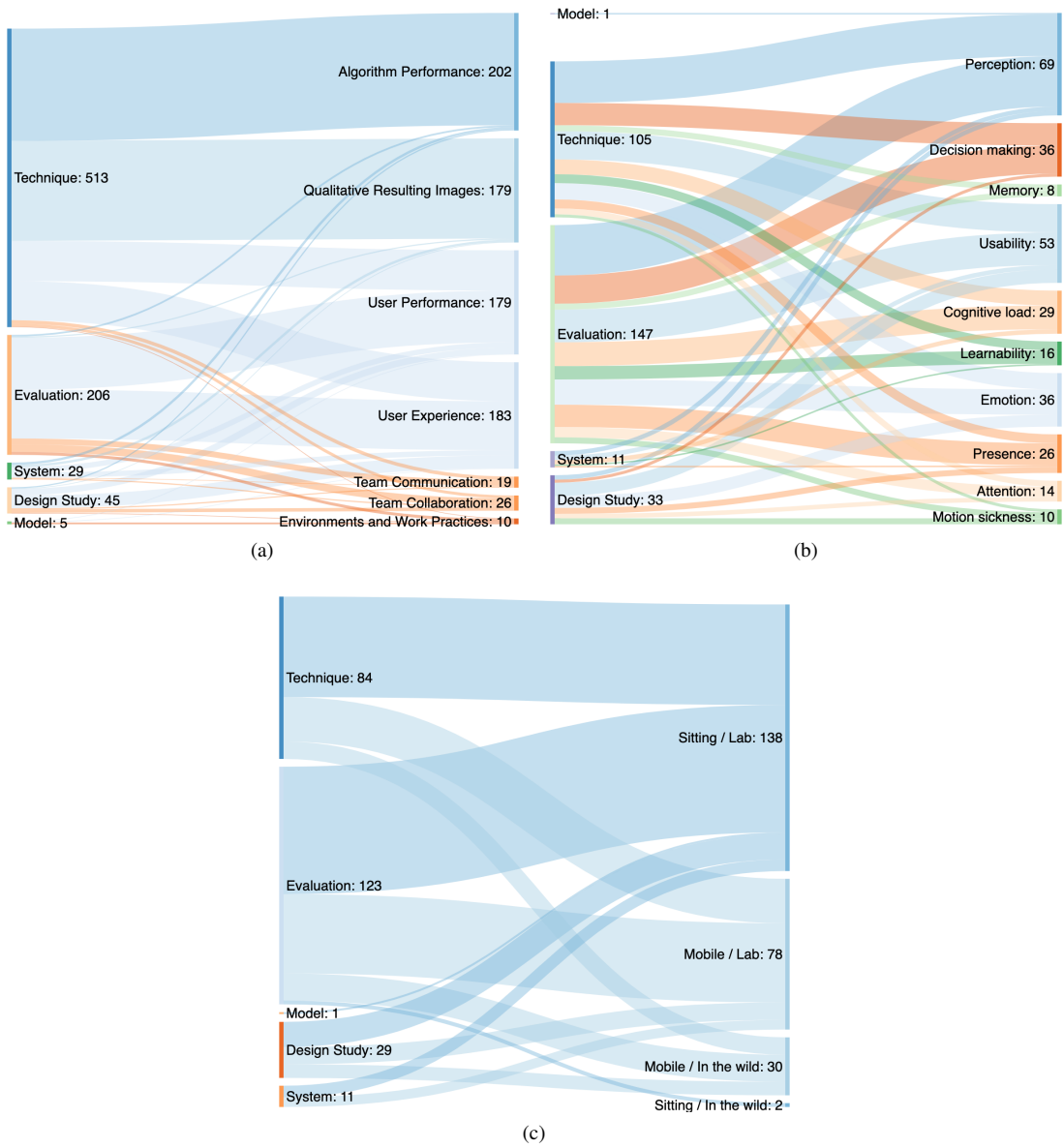
Figure 3: Evaluation scenarios, cognitive aspects, and configurations of user studies by paper types.
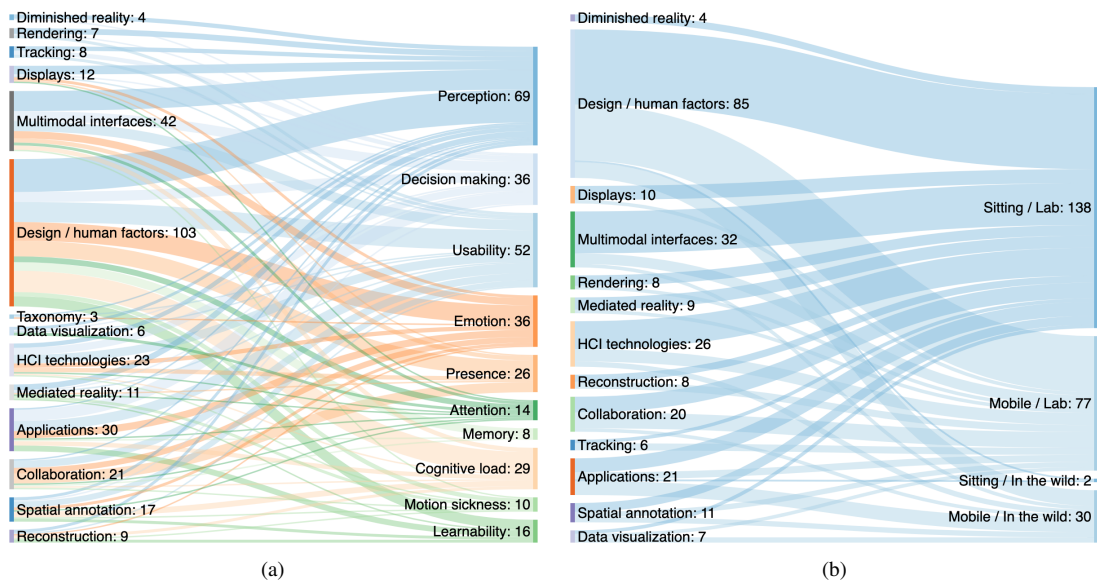
Figure 4: Evaluation scenarios, cognitive aspects, and user study configuration by topics of interest.
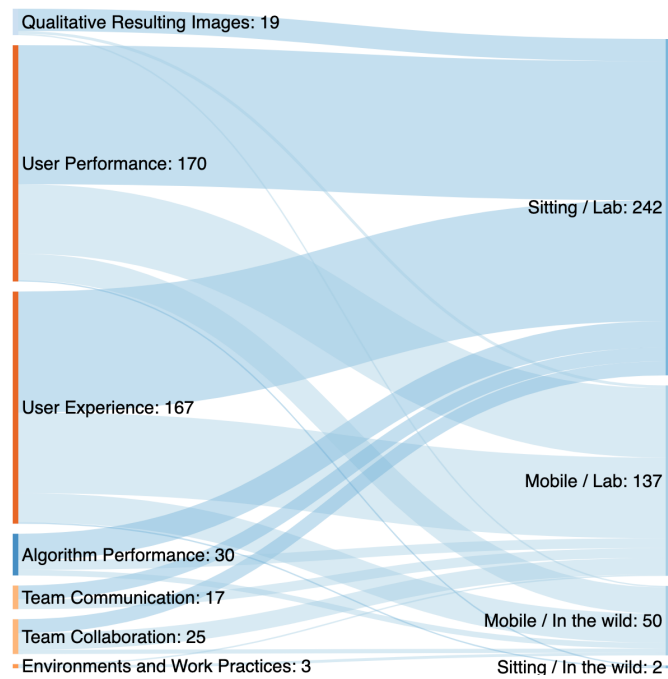
Figure 5: Configurations of user studies by evaluation scenarios.

2.2 Paper Types by Venue
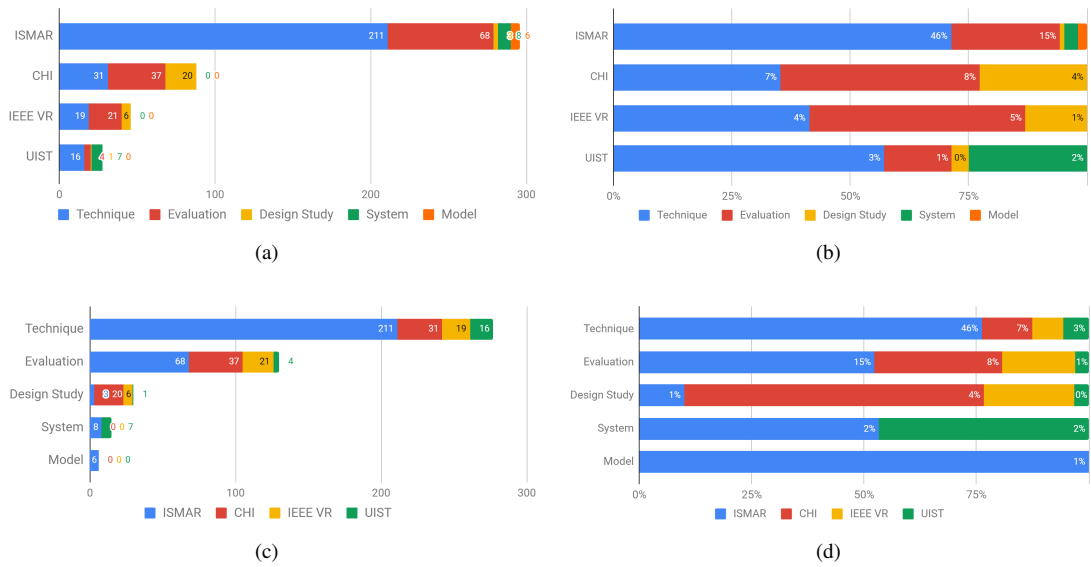
Figure 6: Absolute number and percentage of papers by venue and type.

2.3 Venue by Topics
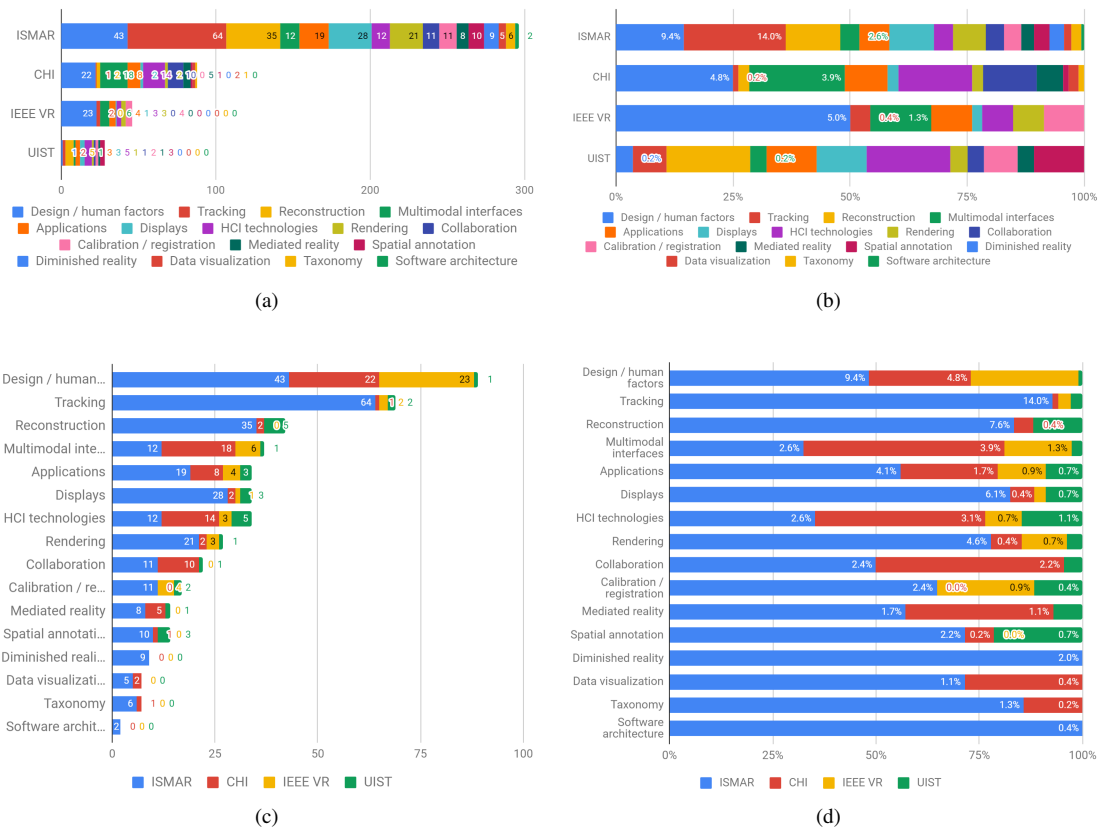
Figure 7: Absolute number and percentage of papers by venue and topic of interest.

2.4 Evaluation Scenarios per Venue

(a)

(b)

(c)

(d)

Figure 8: Absolute number and percentage of papers by venue and evaluation scenario.

2.5 Sample Distributions by Gender
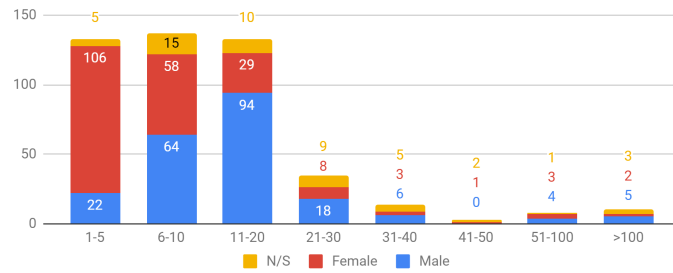
Figure 9: Histogram of participants by gender in evaluations in MR/AR.

2.6 Sample Sizes by Venue
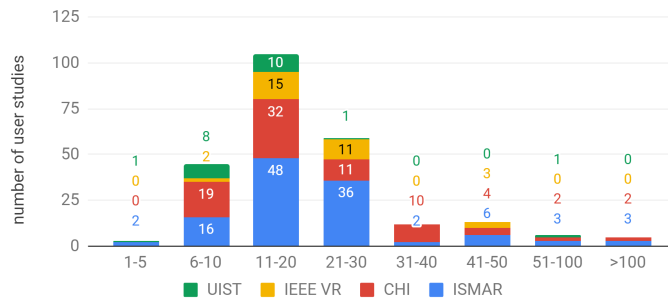
Figure 10: Histogram of participants in evaluations in MR/AR.

2.7 Cognitive Aspects

(a)

(b)

(c)

(d)
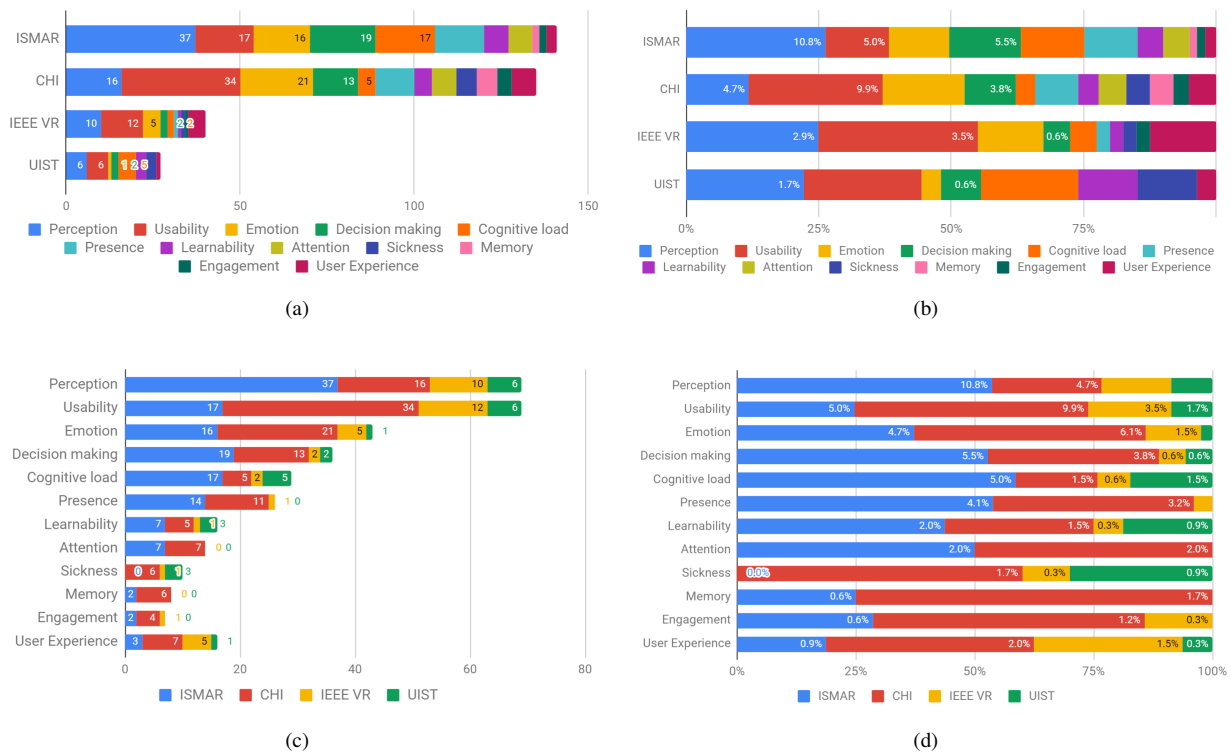
Figure 11: Absolute number and percentage of papers by venue and cognitive aspect.

3 TREND VISUAL ANALYSIS

3.1 Relevant Papers in the Survey

3.1.1 Overall Temporal Distribution of Papers
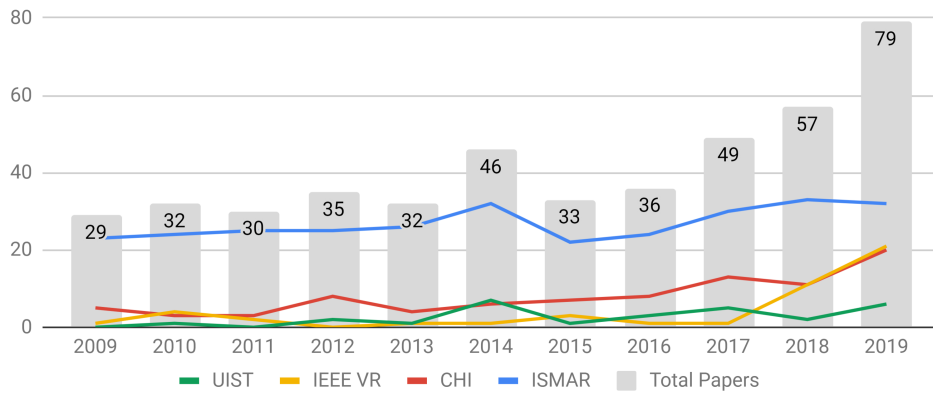
Figure 12: The 458 included papers in our survey by publication year are depicted as grey bars. Colored lines depict the distribution per venue (for more details on the individual venues; see Figure 13).

3.1.2 Temporal Distribution of Papers by Venue
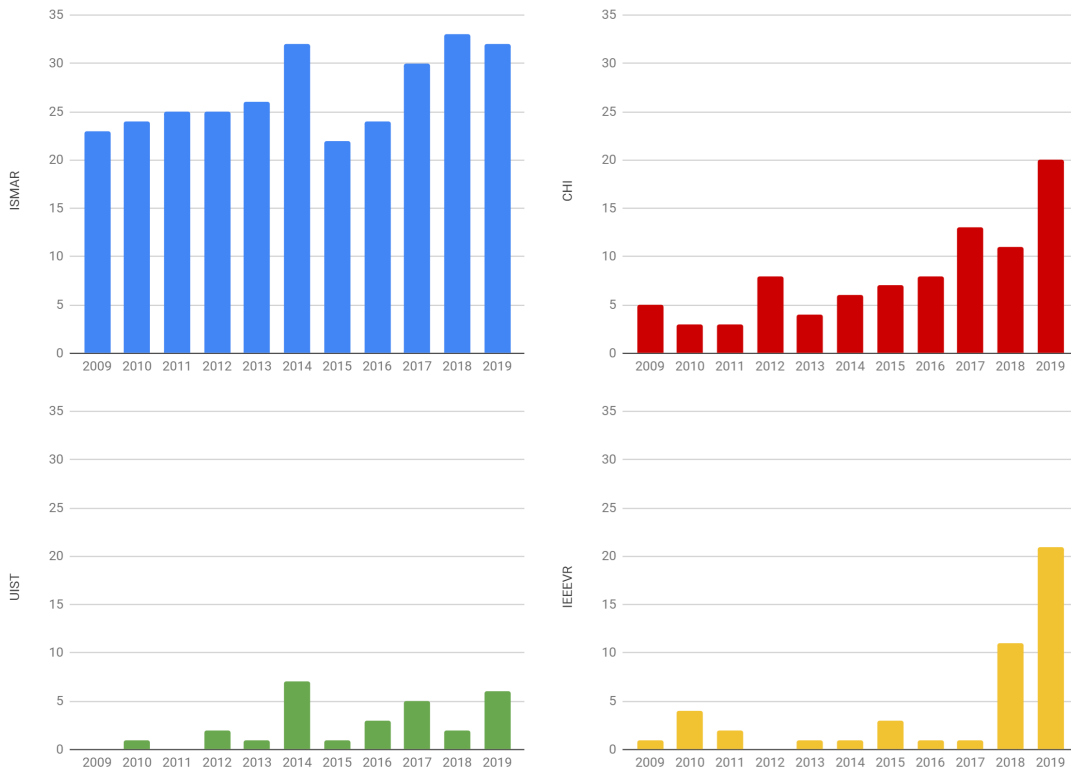
Figure 13: Four bar-charts depict the number of paper by publication year for each considered venue separately.

3.2 Evolution: Paper Types

3.2.1   Overall Evolution of Paper Types
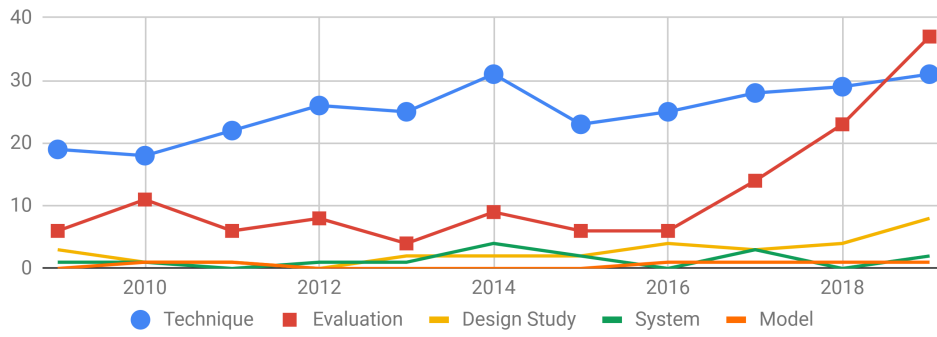
Figure 14: *Absolute* number of publications per year and paper type in 2009–2019.
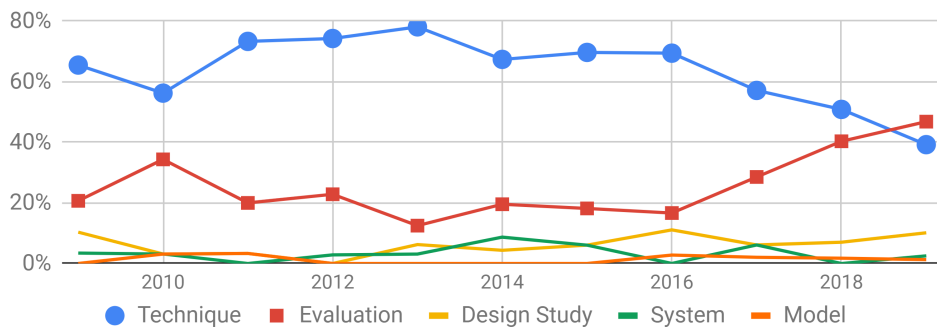
Figure 15: *Relative* ratios between paper types per year in 2009–2019.

3.2.2 Comparing Venues and Evolution of Paper Types
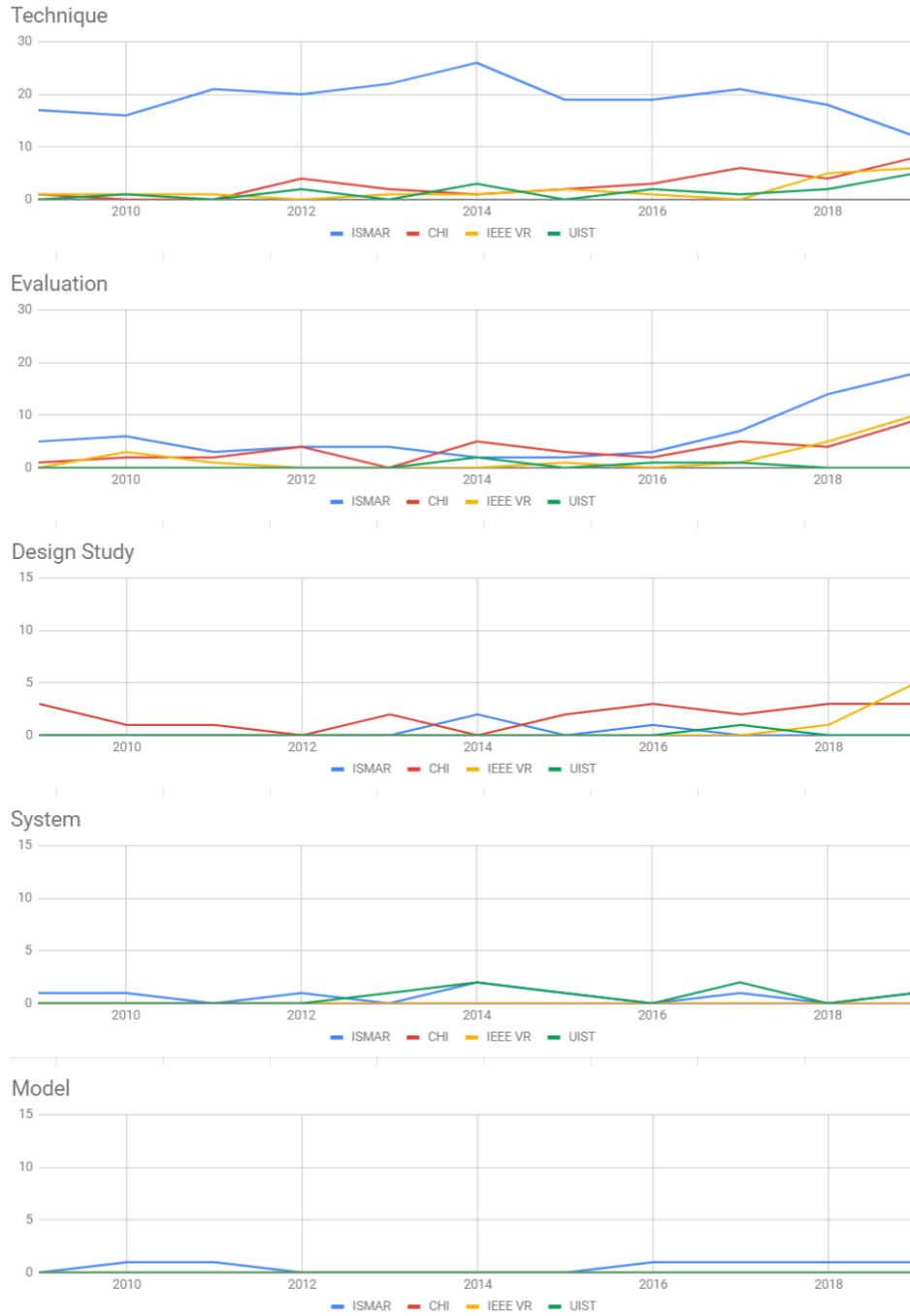
Figure 16: *Absolute* number of publications per year and venue for each paper type in 2009–2019. Note that the vertical axis for *Technique* has a larger scale than the others.

3.2.3 Comparing Paper Types and Evolution of Venues

Figure 17: *Absolute* number of publications per year and paper type for each venue in 2009–2019.

Figure 18: *Relative* ratios between paper types per year for each venue in 2009–2019.

3.3 Evolution: Research Topic

Table 2: Research Topics.

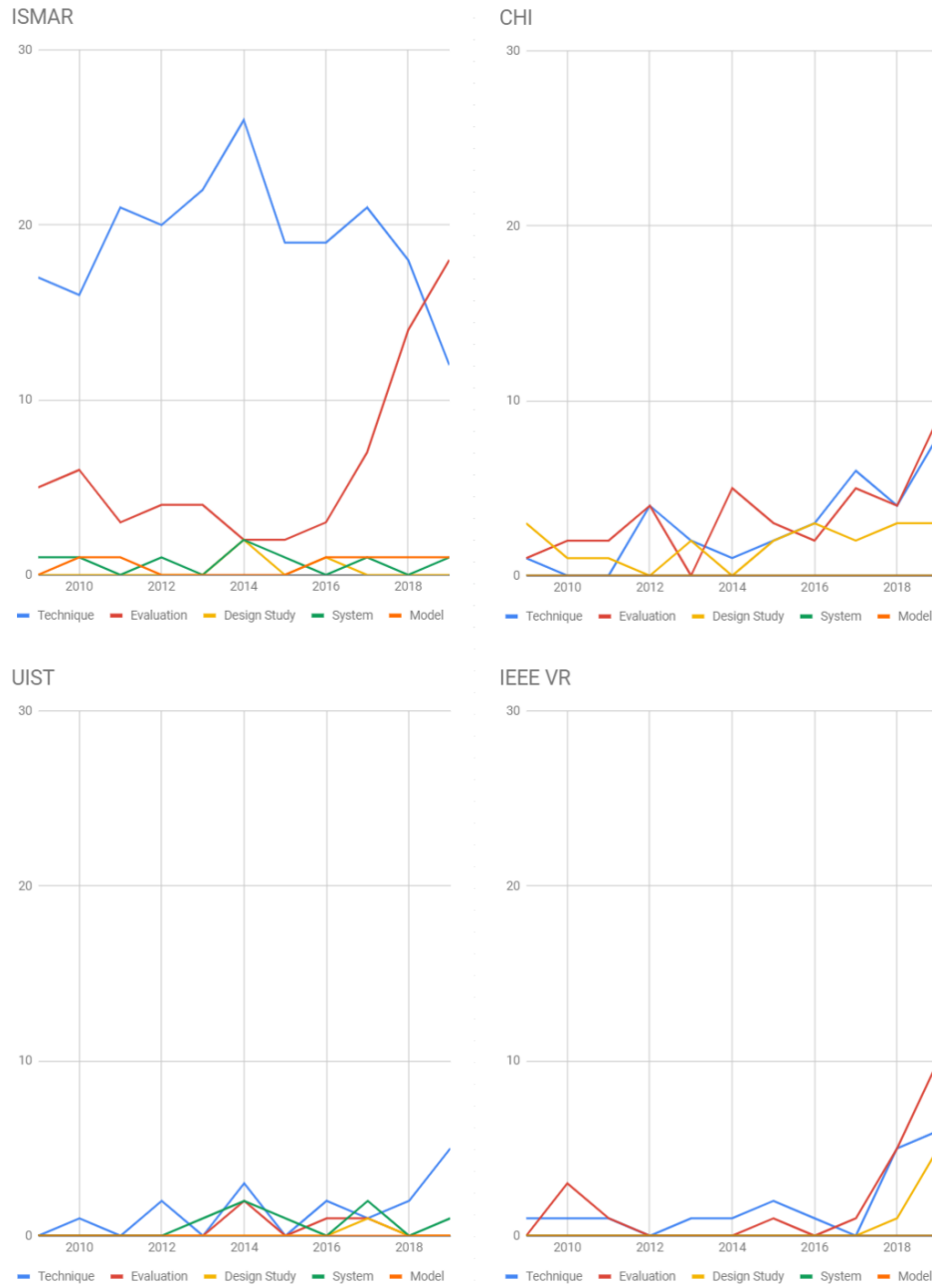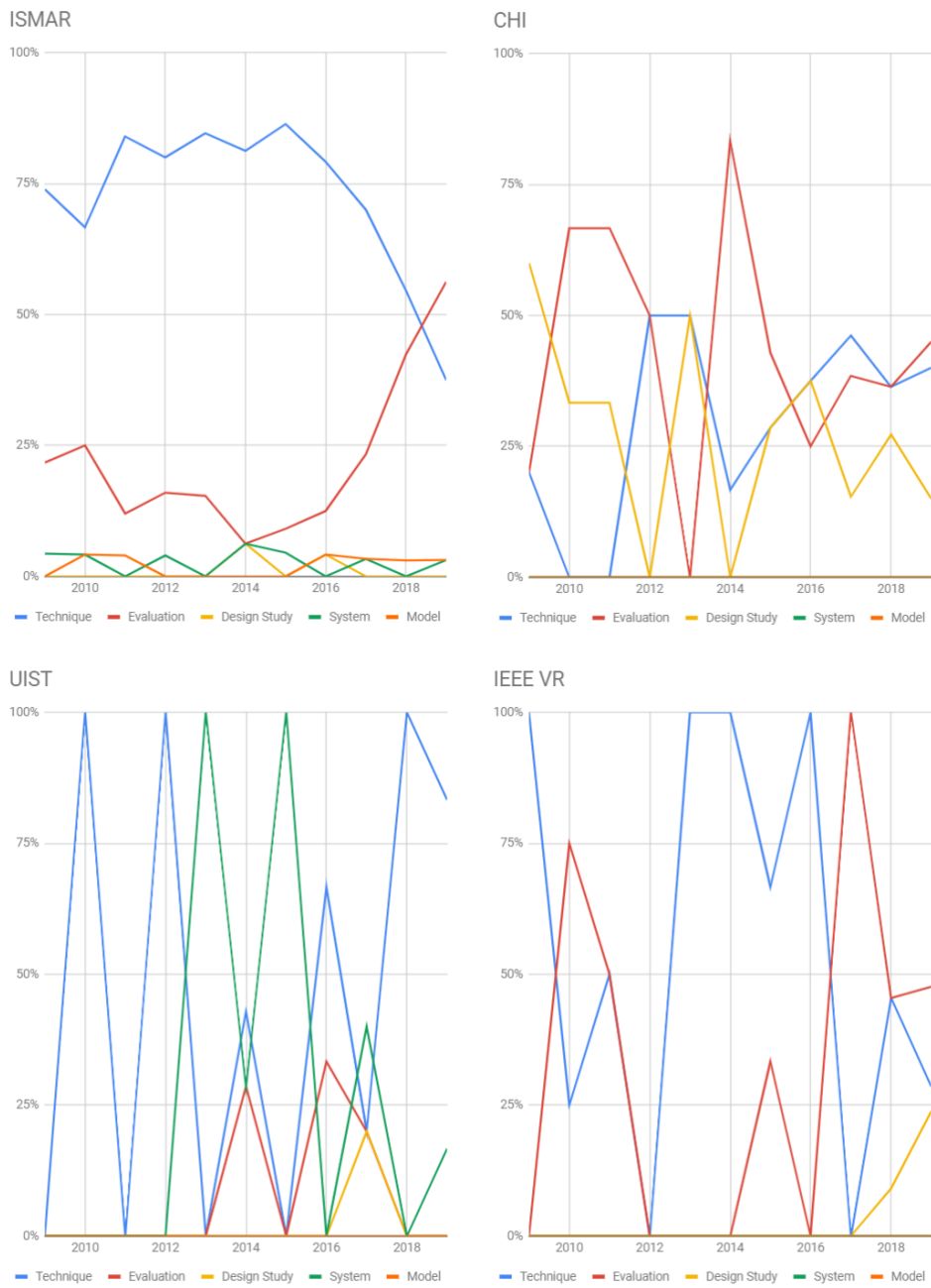|	
Tracking	Papers evolving around 3D tracking. It also contains most papers dealing with simultaneous localization and mapping, if the emphasis is on localization.
Reconstruction	Technical papers focusing on 3D reconstruction, either as a prerequisite for MR/AR applications (which will typically use the reconstructed models to derive some form of spatial annotation), or SLAM papers where the mapping part is most relevant.
Calibration/registration	Papers specifically focusing on spatial registration problems for real-time tracking. These papers will have a thematic overlap with tracking and reconstruction.
Rendering	Papers dealing with coherent rendering, in particular, global illumination for mixed realities, inverse rendering, and photometric registration.
Displays	Papers that deal with physical displays for MR/AR, mostly head-mounted displays and spatial AR.
HCI technologies	Papers discussing technical solutions to interaction problems.
Design/ Human factors	Papers dealing either with the design (and evaluation) of interaction techniques or with the study of human factors per se that occur in the context of MR/AR systems. One important group are perceptual issues, in particular, depth perception.
Applications	Papers exploring MR/AR interfaces in specific application use cases, covering both medical and non-medical applications.
Multimodal interfaces	Papers dealing with audio, haptics, and other non-visual modalities.
Collaboration	Papers describing collaborative MR/AR.
Mediated reality	Papers on changing the appearance of physical objects and scenes.
Spatial annotation	Papers that display semantic information registered to the real world, to instruct or guide the user. Difference to mediated reality is that mainly that the real objects remain mostly visible and are "augmented", not "supplanted".
Data visualization	Papers that elaborate on the display of data registered to the real world in an MR/AR display. Difference to spatial annotation is that the data undergoes a noteworthy visual encoding, as opposed to an annotation, which is usually visually trivial (such as a colored icon or text label).
Diminished reality	Papers on all kinds of techniques that make real things disappear or partially transparent.
Augmented virtuality	Papers on embedding real-world visuals (*e.g.*, from cameras) in virtual environments.
Taxonomy	Papers describing theoretical discussions and taxonomies.
Software architecture	Papers describing software architectures.

3.3.1 Overall Evolution of Research Topics
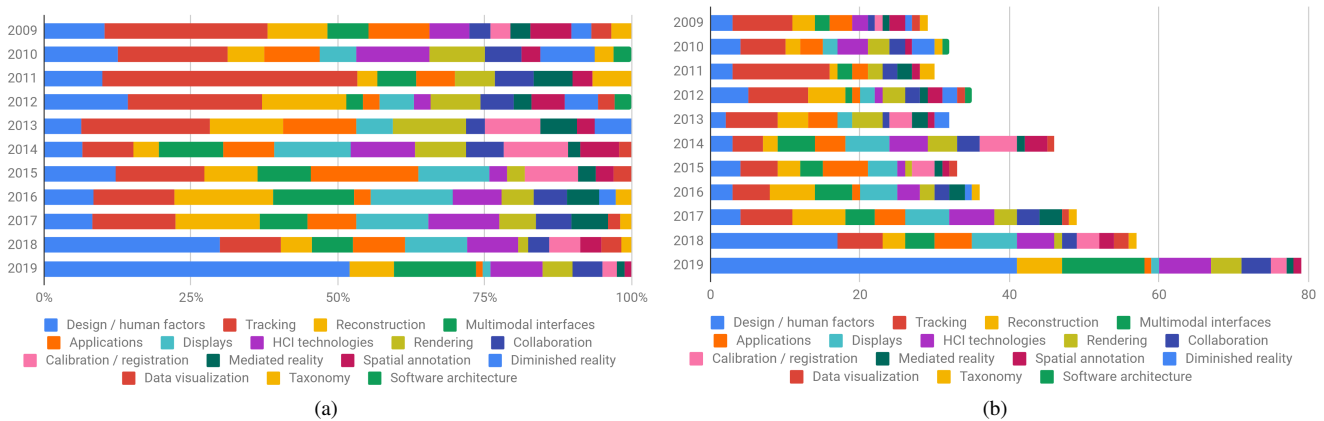
Figure 19: (a) Relative focus of research topics per year; (b) Absolute focus of research topics per year.

3.3.2 Overall Evolution of Research Topics

Figure 20: Evolution of each research topic separately, independent of venue. Note that the scale of the first two research topics (*Tracking* and *Design / Human Factors*) is larger.

3.3.3 Evolution of Research Topics by Venue

(a)

(b)
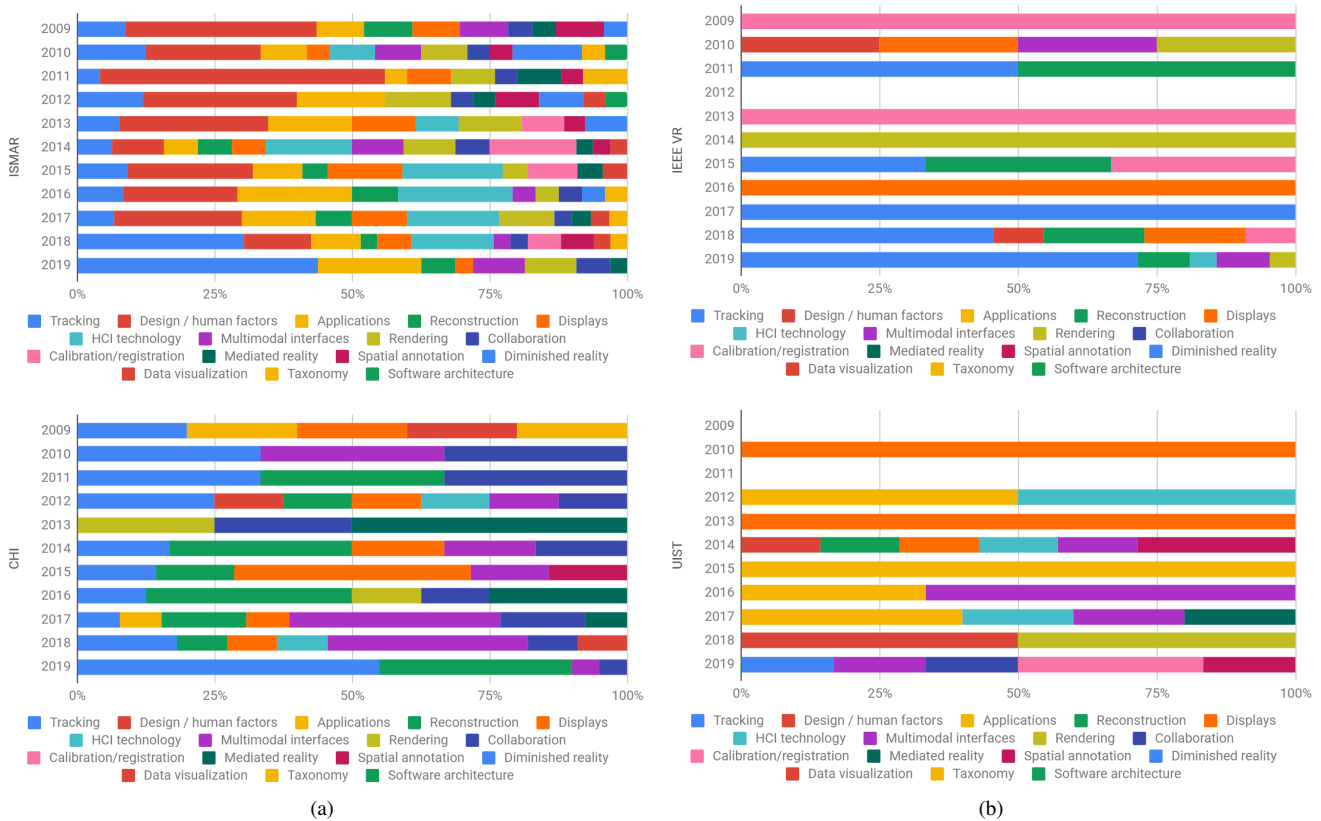
Figure 21: (a) Evolution of research topics grouped by venue. Depicts ratio between different research topics for each year; (b) Evolution of research topics grouped by venue).

3.4 Evolution: Evaluation Scenarios

3.4.1 Overall Evolution of Evaluation Scenarios
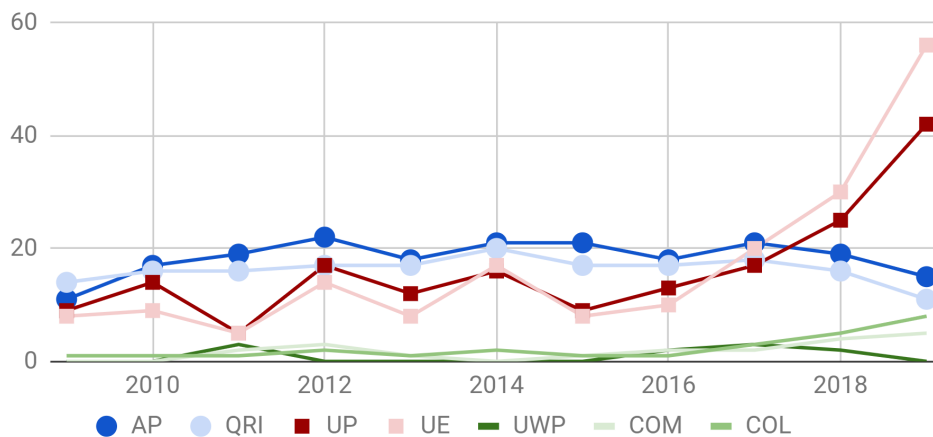
Figure 22: Trends of evaluation scenarios in 2009–2019 in MR/AR: Algorithm Performance (AP), Qualitative Results Inspection (QRI), User Performance (UP), User Experience (UE), Understanding environment and Work Practices (UWP), Team Communication (COM), and Team Collaboration (COL).
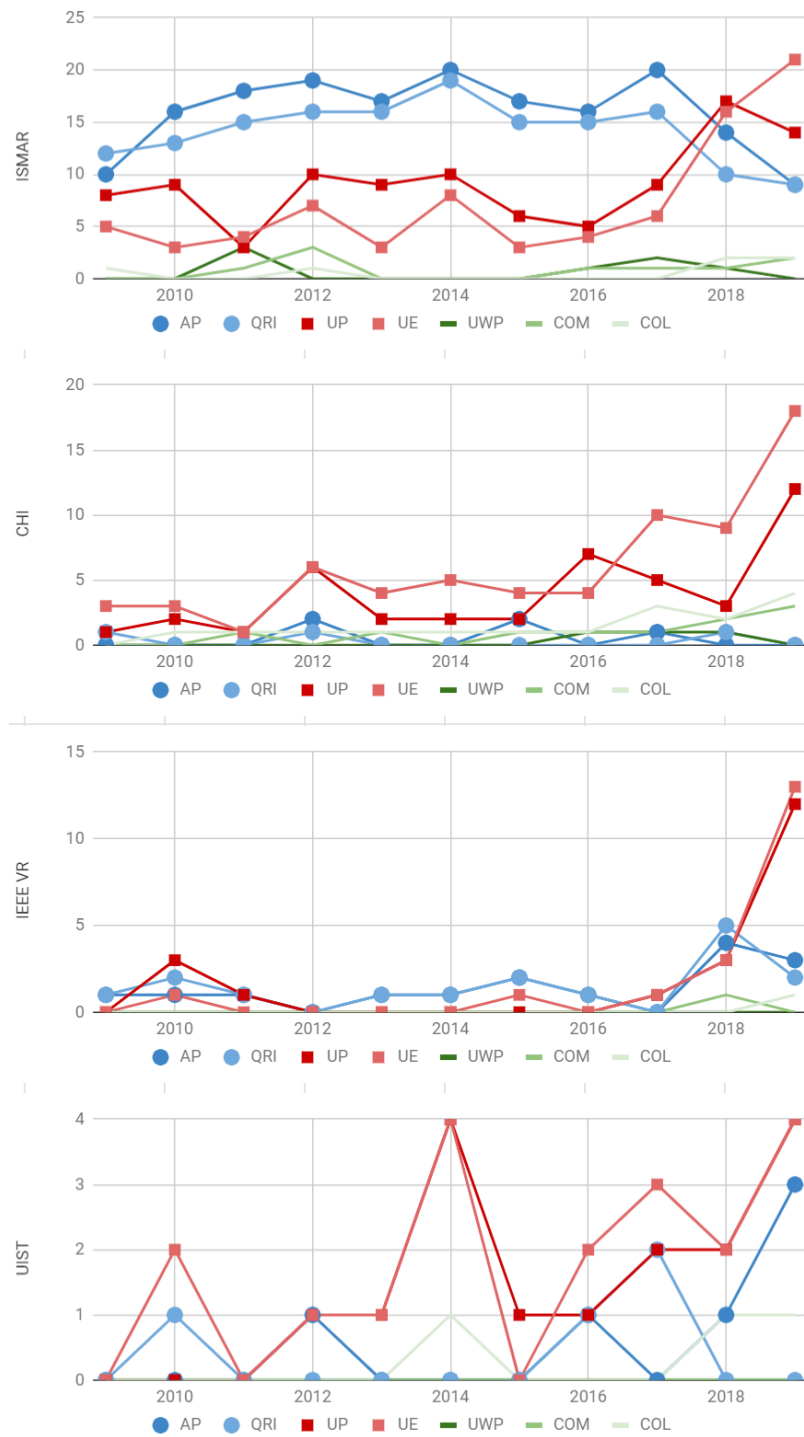
Figure 23: Trends of evaluation scenarios in 2009–2019 in MR/AR - grouped by venue.

REFERENCES

[1] K. Ahuja, S. Pareddy, R. Xiao, M. Goel, and C. Harrison. Lightanchors: Appropriating point lights for spatially-anchored augmented reality interfaces. In *Proceedings of the 32nd Annual ACM Symposium on User Interface Software and Technology*, UIST '19, p. 189–196. Association for Computing Machinery, New York, NY, USA, 2019. doi: 10.1145/3332165.3347884

[2] M. Al-Kalbani, I. Williams, and M. Frutos-Pascual. Analysis of medium wrap freehand virtual object grasping in exocentric mixed reality. In *IEEE International Symposium on Mixed and Augmented Reality*, pp. 84–93, 2016.

[3] F. Anderson, T. Grossman, J. Matejka, and G. Fitzmaurice. Youmove: Enhancing movement training with an augmented reality mirror. In *Proceedings of the 26th Annual ACM Symposium on User Interface Software and Technology*, UIST '13, p. 311–320. Association for Computing Machinery, New York, NY, USA, 2013. doi: 10.1145/2501988.2502045

[4] C. Arth, M. Klopschitz, G. Reitmayr, and D. Schmalstieg. Real-time self-localization from panoramic images on mobile devices. In *IEEE International Symposium on Mixed and Augmented Reality*, pp. 37–46, 2011.

[5] C. Arth, C. Pirchheim, J. Ventura, D. Schmalstieg, and V. Lepetit. Instant outdoor localization and SLAM initialization from 2.5D maps. *Transactions on Visualization and Computer Graphics*, 21(11):1309–1318, 2015.

[6] C. Arth, D. Wagner, M. Klopschitz, A. Irschara, and D. Schmalstieg. Wide area localization on mobile phones. In *IEEE International Symposium on Mixed and Augmented Reality*, pp. 73–82, 2009.

[7] E. Azimi, A. Winkler, E. Tucker, L. Qian, M. Sharma, J. Doswell, N. Navab, and P. Kazanzides. Evaluation of optical see-through head-mounted displays in training for critical care and trauma. In *2018 IEEE Conference on Virtual Reality and 3D User Interfaces (VR)*, pp. 1–9, 2018.

[8] B. W. Babu, S. Kim, Z. Yan, and L. Ren. σ-DVO: Sensor noise model meets dense visual odometry. In *IEEE International Symposium on Mixed and Augmented Reality*, pp. 18–26, 2016.

[9] P. K. Baheti, A. Swaminathan, M. Chari, S. Diaz, and S. Grzechnik. Information-theoretic database building and querying for mobile augmented reality applications. In *IEEE International Symposium on Mixed and Augmented Reality*, pp. 47–53, 2011.

[10] Z. Bai, A. F. Blackwell, and G. Coulouris. Through the looking glass: Pretend play for children with autism. In *IEEE International Symposium on Mixed and Augmented Reality*, pp. 49–58, 2013.

[11] Z. Bai, A. F. Blackwell, and G. Coulouris. Exploring expressive augmented reality: The fingar puppet system for social pretend play. In *Proceedings of the 33rd Annual ACM Conference on Human Factors in Computing Systems*, CHI '15, pp. 1035–1044. ACM, New York, NY, USA, 2015. doi: 10.1145/2702123.2702250

[12] S. Balasubramanian and R. Soundararajan. Prediction of discomfort due to egomotion in immersive videos for virtual reality. In *2019 IEEE International Symposium on Mixed and Augmented Reality (ISMAR)*, pp. 169–177, 2019.

[13] Y. Ban, T. Narumi, T. Fujii, S. Sakurai, J. Imura, T. Tanikawa, and M. Hirose. Augmented endurance: Controlling fatigue while handling objects by affecting weight perception using augmented reality. In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems*, CHI '13, pp. 69–78. ACM, New York, NY, USA, 2013. doi: 10.1145/2470654.2470665

[14] A. Bapat, E. Dunn, and J. Frahm. Towards kilo-hertz 6-DoF visual tracking using an egocentric cluster of rolling shutter cameras. *Transactions on Visualization and Computer Graphics*, 22(11):2358–2367, 2016.

[15] D. Baričević, C. Lee, M. Turk, T. Höllerer, and D. A. Bowman. A hand-held AR magic lens with user-perspective rendering. In *IEEE International Symposium on Mixed and Augmented Reality*, pp. 197–206, 2012.

[16] P. Barnum, Y. Sheikh, A. Datta, and T. Kanade. Dynamic seethroughs: Synthesizing hidden views of moving objects. In *IEEE International Symposium on Mixed and Augmented Reality*, pp. 111–114, 2009.

[17] J. Bastian, B. Ward, R. Hill, A. van den Hengel, and A. Dick. Interactive modelling for AR applications. In *IEEE International Symposium on Mixed and Augmented Reality*, pp. 199–205, 2010.

[18] A. U. Batmaz, M. D. B. Machuca, D. M. Pham, and W. Stuerzlinger. Do head-mounted display stereo deficiencies affect 3d pointing tasks in ar and vr? In *2019 IEEE Conference on Virtual Reality and 3D User Interfaces (VR)*, pp. 585–592, 2019.

[19] J. Baumeister, S. Y. Ssin, N. A. M. ElSayed, J. Dorrian, D. P. Webb, J. A. Walsh, T. M. Simon, A. Irlitti, R. T. Smith, M. Kohler, and B. H. Thomas. Cognitive cost of using augmented reality displays. *Transactions on Visualization and Computer Graphics*, 23(11):2378–2388, 2017.

[20] D. Baur, S. Boring, and S. Feiner. Virtual projection: Exploring optical projection as a metaphor for multi-device interaction. In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems*, CHI '12, pp. 1693–1702. ACM, New York, NY, USA, 2012. doi: 10.1145/2207676.2208297

[21] S. Benford, A. Hazzard, A. Chamberlain, K. Glover, C. Greenhalgh, L. Xu, M. Hoare, and D. Darzentas. Accountable artefacts: The case of the carolan guitar. In *Proceedings of the 2016 CHI Conference on Human Factors in Computing Systems*, CHI '16, pp. 1163–1175. ACM, New York, NY, USA, 2016. doi: 10.1145/2858036.2858306

[22] S. Benford, B. Koleva, W. W. Preston, A. Angus, E.-C. Thorn, and K. Glover. Customizing hybrid products. In *Proceedings of the 2018 CHI Conference on Human Factors in Computing Systems*, CHI '18, pp. 30:1–30:12. ACM, New York, NY, USA, 2018. doi: 10.1145/3173574.3173604

[23] H. Benko, A. D. Wilson, and F. Zannier. Dyadic projected spatial augmented reality. In *Proceedings of the 27th Annual ACM Symposium on User Interface Software and Technology*, UIST '14, p. 645–655. Association for Computing Machinery, New York, NY, USA, 2014. doi: 10.1145/2642918.2647402

[24] O. Bergig, N. Hagbi, J. El-Sana, and M. Billinghurst. In-place 3D sketching for authoring and augmenting mechanical systems. In *IEEE International Symposium on Mixed and Augmented Reality*, pp. 87–94, 2009.

[25] M. Berning, D. Kleinert, T. Riedel, and M. Beigl. A study of depth perception in hand-held augmented reality using autostereoscopic displays. In *IEEE International Symposium on Mixed and Augmented Reality*, pp. 93–98, 2014.

[26] A. Bhattacharya, T. W. Windleharth, R. A. Ishii, I. M. Acevedo, C. R. Aragon, J. A. Kientz, J. C. Yip, and J. H. Lee. Group interactions in location-based gaming: A case study of raiding in pokémon go. In *Proceedings of the 2019 CHI Conference on Human Factors in Computing Systems*, CHI '19, p. 1–12. Association for Computing Machinery, New York, NY, USA, 2019. doi: 10.1145/3290605.3300817

[27] C. Bichlmeier, E. Euler, T. Blum, and N. Navab. Evaluation of the virtual mirror as a navigational aid for augmented reality driven minimally invasive procedures. In *IEEE International Symposium on Mixed and Augmented Reality*, pp. 91–97, 2010.

[28] G. Bleser, G. Hendeby, and M. Miezal. Using egocentric vision to achieve robust inertial body tracking under magnetic disturbances. In *IEEE International Symposium on Mixed and Augmented Reality*, pp. 103–109, 2011.

[29] T. Blum, M. Wieczorek, A. Aichert, R. Tibrewal, and N. Navab. The effect of out-of-focus blur on visual discomfort when using stereo displays. In *IEEE International Symposium on Mixed and Augmented Reality*, pp. 13–17, 2010.

[30] F. Bork, R. Barmaki, U. Eck, K. Yu, C. Sandor, and N. Navab. Empirical study of non-reversing magic mirrors for augmented reality anatomy learning. In *IEEE International Symposium on Mixed and Augmented Reality*, pp. 169–176, 2017.

[31] F. Bork, B. Fuers, A. Schneider, F. Pinto, C. Graumann, and N. Navab. Auditory and visio-temporal distance coding for 3-dimensional perception in medical augmented reality. In *IEEE International Symposium on Mixed and Augmented Reality*, pp. 7–12, 2015.

[32] F. Bork, C. Schnelzer, U. Eck, and N. Navab. Towards efficient visual guidance in limited field-of-view head-mounted displays. *Transactions on Visualization and Computer Graphics*, 24(11):2983–2992, 2018.

[33] G. Bruder, P. Wieland, B. Bolte, M. Lappe, and F. Steinicke. Going with the flow: Modifying self-motion perception with computer-mediated optic flow. In *IEEE International Symposium on Mixed and Augmented Reality*, pp. 67–74, 2013.

[34] S. Butscher, S. Hubenschmid, J. Müller, J. Fuchs, and H. Reiterer. Clusters, trends, and outliers: How immersive technologies can facilitate the collaborative analysis of multidimensional data. In *Proceedings of the 2018 CHI Conference on Human Factors in Computing Systems*, CHI '18, pp. 90:1–90:12. ACM, New York, NY, USA, 2018. doi: 10.1145/3173574.3173664

[35] B. Cassidy, J. C. Read, and I. S. MacKenzie. An evaluation of radar metaphors for providing directional stimuli using non-verbal sound. In *Proceedings of the 2019 CHI Conference on Human Factors in Computing Systems*, CHI '19, p. 1–8. Association for Computing Machinery, New York, NY, USA, 2019. doi: 10.1145/3290605.3300289

[36] Y. Cha, T. Price, Z. Wei, X. Lu, N. Rewkowski, R. Chabra, Z. Qin, H. Kim, Z. Su, Y. Liu, A. Ilie, A. State, Z. Xu, J. Frahm, and H. Fuchs. Towards fully mobile 3D face, body, and environment capture using only head-worn cameras. *Transactions on Visualization and Computer Graphics*, 24(11):2993–3004, 2018.

[37] H. J. Chae, J.-i. Hwang, and J. Seo. Wall-based space manipulation technique for efficient placement of distant objects in augmented reality. In *Proceedings of the 31st Annual ACM Symposium on User Interface Software and Technology*, UIST '18, p. 45–52. Association for Computing Machinery, New York, NY, USA, 2018. doi: 10.1145/3242587.3242631

[38] P. Chakravarthula, D. Dunn, K. Akşit, and H. Fuchs. FocusAR: Auto-focus augmented reality eyeglasses for both real world and virtual imagery. *Transactions on Visualization and Computer Graphics*, 24(11):2906–2916, 2018.

[39] J. Chen, G. Turk, and B. MacIntyre. A non-photorealistic rendering framework with temporal coherence for augmented reality. In *IEEE International Symposium on Mixed and Augmented Reality*, pp. 151–160, 2012.

[40] L. Chen, T. W. Day, W. Tang, and N. W. John. Recent developments and future challenges in medical mixed reality. In *IEEE International Symposium on Mixed and Augmented Reality*, pp. 123–135, 2017.

[41] L.-P. Cheng, E. Ofek, C. Holz, H. Benko, and A. D. Wilson. Sparse haptic proxy: Touch feedback in virtual environments using a general passive prop. In *Proceedings of the 2017 CHI Conference on Human Factors in Computing Systems*, CHI '17, pp. 3718–3728. ACM, New York, NY, USA, 2017. doi: 10.1145/3025453.3025753

[42] H. Chiu, V. Murali, R. Villamil, G. D. Kessler, S. Samarasekera, and R. Kumar. Augmented reality driving using semantic geo-registration. In *2018 IEEE Conference on Virtual Reality and 3D User Interfaces (VR)*, pp. 423–430, 2018.

[43] M. A. Cidota, P. J. M. Bank, and S. G. Lukosch. Design recommendations for augmented reality games for objective assessment of upper extremity motor dysfunction. In *2019 IEEE Conference on Virtual Reality and 3D User Interfaces (VR)*, pp. 1430–1438, 2019.

[44] M. A. Cidota, P. J. M. Bank, P. W. Ouwehand, and S. G. Lukosch. Assessing upper extremity motor dysfunction using an augmented reality game. In *IEEE International Symposium on Mixed and Augmented Reality*, pp. 144–154, 2017.

[45] C. Coffin, C. Lee, and T. Höllerer. Evaluating the impact of recovery density on augmented reality tracking. In *IEEE International Symposium on Mixed and Augmented Reality*, pp. 93–101, 2011.

[46] M. Cohen, K. R. Dillman, H. MacLeod, S. Hunter, and A. Tang. Onespace: Shared visual scenes for active freeplay. In *Proceedings of the 32Nd Annual ACM Conference on Human Factors in Computing Systems*, CHI '14, pp. 2177–2180. ACM, New York, NY, USA, 2014. doi: 10.1145/2556288.2557117

[47] J. Collins, H. Regenbrecht, T. Langlotz, Y. Said Can, C. Ersoy, and R. Butson. Measuring cognitive load and insight: A methodology exemplified in a virtual reality learning context. In *2019 IEEE International Symposium on Mixed and Augmented Reality (ISMAR)*, pp. 351–362, 2019.

[48] T. Collins, D. Pizarro, A. Bartoli, M. Canis, and N. Bourdel. Computer-assisted laparoscopic myomectomy by augmenting the uterus with pre-operative MRI data. In *IEEE International Symposium on Mixed and Augmented Reality*, pp. 243–248, 2014.

[49] F. I. Cosco, C. Garre, F. Bruno, M. Muzzupappa, and M. A. Otaduy. Augmented touch without visual obtrusion. In *IEEE International Symposium on Mixed and Augmented Reality*, pp. 99–102, 2009.

[50] A. Dame and E. Marchand. Accurate real-time tracking using mutual information. In *IEEE International Symposium on Mixed and Augmented Reality*, pp. 47–56, 2010.

[51] J. David Hincapié-Ramos, L. Ivanchuk, S. K. Sridharan, and P. Irani. SmartColor: Real-time color correction and contrast for optical see-through head-mounted displays. In *IEEE International Symposium on Mixed and Augmented Reality*, pp. 187–194, 2014.

[52] X. de Tinguy, C. Pacchierotti, M. Marchal, and A. Lécuyer. Enhancing the stiffness perception of tangible objects in mixed reality using wearable haptics. In *2018 IEEE Conference on Virtual Reality and 3D User Interfaces (VR)*, pp. 81–90, 2018.

[53] D. Dewez, R. Fribourg, F. Argelaguet, L. Hoyet, D. Mestre, M. Slater, and A. Lécuyer. Influence of personality traits and body awareness on the sense of embodiment in virtual reality. In *2019 IEEE International Symposium on Mixed and Augmented Reality (ISMAR)*, pp. 123–134, 2019.

[54] A. Dey, H. Chen, A. Hayati, M. Billinghurst, and R. W. Lindeman. Sharing manipulated heart rate feedback in collaborative virtual environments. In *2019 IEEE International Symposium on Mixed and Augmented Reality (ISMAR)*, pp. 248–257, 2019.

[55] A. Dey, H. Chen, C. Zhuang, M. Billinghurst, and R. W. Lindeman. Effects of sharing real-time multi-sensory heart rate feedback in different immersive collaborative virtual environments. In *IEEE International Symposium on Mixed and Augmented Reality*, pp. 165–173, 2018.

[56] A. Dey, G. Jarvis, C. Sandor, and G. Reitmayr. Tablet versus phone: Depth perception in handheld augmented reality. In *IEEE International Symposium on Mixed and Augmented Reality*, pp. 187–196, 2012.

[57] C. Diaz, M. Walker, D. A. Szafir, and D. Szafir. Designing for depth perceptions in augmented reality. In *IEEE International Symposium on Mixed and Augmented Reality*, pp. 111–122, 2017.

[58] J. Domínguez-Conti, J. Yin, Y. Alami, and J. Civera. Visual-inertial SLAM initialization: A general linear formulation and a gravity-observing non-linear optimization. In *IEEE International Symposium on Mixed and Augmented Reality*, pp. 37–45, 2018.

[59] S. Dong and T. Höllerer. Real-time re-textured geometry modeling using microsoft hololens. In *2018 IEEE Conference on Virtual Reality and 3D User Interfaces (VR)*, pp. 231–237, 2018.

[60] M. Donoser, P. Kontschieder, and H. Bischof. Robust planar target tracking and pose estimation from a single concavity. In *IEEE International Symposium on Mixed and Augmented Reality*, pp. 9–15, 2011.

[61] M. Dou, H. Fuchs, and J.-M. Frahm. Scanning and tracking dynamic objects with commodity depth cameras. In *IEEE International Symposium on Mixed and Augmented Reality*, pp. 99–106, 2013.

[62] C. Du, Y. Chen, M. Ye, and L. Ren. Edge snapping-based depth enhancement for dynamic occlusion handling in augmented reality. In *IEEE International Symposium on Mixed and Augmented Reality*, pp. 54–62, 2016.

[63] N. Ducheneaut, M.-H. Wen, N. Yee, and G. Wadley. Body and mind: A study of avatar personalization in three virtual worlds. In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems*, CHI '09, pp. 1151–1160. ACM, New York, NY, USA, 2009. doi: 10.1145/1518701. 1518877

[64] J. Dudley, H. Benko, D. Wigdor, and P. O. Kristensson. Performance envelopes of virtual keyboard text input strategies in virtual reality. In *2019 IEEE International Symposium on Mixed and Augmented Reality (ISMAR)*, pp. 289–300, 2019.

[65] U. Eck, F. Pankratz, C. Sandor, G. Klinker, and H. Laga. Comprehensive workspace calibration for visuo-haptic augmented reality. In *IEEE International Symposium on Mixed and Augmented Reality*, pp. 123–128, 2014.

[66] A. Erickson, K. Kim, R. Schubert, G. Bruder, and G. Welch. Is it cold in here or is it just me? analysis of augmented reality temperature visualization for computer-mediated thermoception. In *2019 IEEE International Symposium on Mixed and Augmented Reality (ISMAR)*, pp. 202–211, 2019.

[67] A. Esteves, D. Verweij, L. Suraiya, R. Islam, Y. Lee, and I. Oakley. Smoothmoves: Smooth pursuits head movements for augmented reality. In *Proceedings of the 30th Annual ACM Symposium on User Interface Software and Technology*, UIST '17, p. 167–178. Association for Computing Machinery, New York, NY, USA, 2017. doi: 10.1145/3126594.3126616

[68] L. Feng, X. Yang, and S. Xiao. Magictoon: A 2d-to-3d creative cartoon modeling system with mobile ar. In *2017 IEEE Virtual Reality (VR)*, pp. 195–204, 2017.

[69] T. Feuchtner and J. Müller. Extending the body for interaction with reality. In *Proceedings of the 2017 CHI Conference on Human Factors in Computing Systems*, CHI '17, pp. 5145–5157. ACM, New York, NY, USA, 2017. doi: 10.1145/3025453.3025689

[70] D. J. Finnegan, E. O'Neill, and M. J. Proulx. Compensating for distance compression in audiovisual virtual environments using incongruence. In *Proceedings of the 2016 CHI Conference on Human Factors in Computing Systems*, CHI '16, pp. 200–212. ACM, New York, NY, USA, 2016. doi: 10. 1145/2858036.2858065

[71] P. Fite-Georgel. Is there a reality in industrial augmented reality? In *IEEE International Symposium on Mixed and Augmented Reality*, pp. 201–210, 2011.

[72] A. Fond, M. Berger, and G. Simon. Facade proposals for urban augmented reality. In *IEEE International Symposium on Mixed and Augmented Reality*, pp. 32–41, 2017.

[73] E. Foxlin, T. Calloway, and H. Zhang. Improved registration for vehicular AR using auto-harmonization. In *IEEE International Symposium on Mixed and Augmented Reality*, pp. 105–112, 2014.

[74] A. S. Frangos, T. Lee, D. To, and I. Giannopulu. Dorsal and ventral pathways implications in an augmented reality environment. In *2019 IEEE Conference on Virtual Reality and 3D User Interfaces (VR)*, pp. 1658–1662, 2019.

[75] T. A. Franke. Delta light propagation volumes for mixed reality. In *IEEE International Symposium on Mixed and Augmented Reality*, pp. 125–132, 2013.

[76] T. A. Franke. Delta voxel cone tracing. In *IEEE International Symposium on Mixed and Augmented Reality*, pp. 39–44, 2014.

[77] J. Frey, R. Gervais, S. Fleck, F. Lotte, and M. Hachet. Teegi: Tangible eeg interface. In *Proceedings of the 27th Annual ACM Symposium on User Interface Software and Technology*, UIST '14, p. 301–308. Association for Computing Machinery, New York, NY, USA, 2014. doi: 10.1145/2642918. 2647368

[78] W.-T. Fu, J. Gasper, and S.-W. Kim. Effects of an in-car augmented reality system on improving safety of younger and older drivers. In *IEEE International Symposium on Mixed and Augmented Reality*, pp. 59–66, 2013.

[79] T. Fukiage, T. Oishi, and K. Ikeuchi. Reduction of contradictory partial occlusion in mixed reality by using characteristics of transparency perception. In *IEEE International Symposium on Mixed and Augmented Reality*, pp. 129–139, 2012.

[80] T. Fukiage, T. Oishi, and K. Ikeuchi. Visibility-based blending for real-time applications. In *IEEE International Symposium on Mixed and Augmented Reality*, pp. 63–72, 2014.

[81] J. L. Gabbard, J. E. Swan, J. Zedlitz, and W. W. Winchester. More than meets the eye: An engineering study to empirically examine the blending of real and virtual color spaces. In *2010 IEEE Virtual Reality Conference (VR)*, pp. 79–86, 2010.

[82] Y. Gaffary, B. Le Gouis, M. Marchal, F. Argelaguet, B. Arnaldi, and A. Lécuyer. AR feels "softer" than VR: Haptic perception of stiffness in augmented versus virtual reality. *Transactions on Visualization and Computer Graphics*, 23(11):2372–2377, 2017.

[83] W. Gai, C. Yang, Y. Bian, C. Shen, X. Meng, L. Wang, J. Liu, M. Dong, C. Niu, and C. Lin. Supporting easy physical-to-virtual creation of mobile vr maze games: A new genre. In *Proceedings of the 2017 CHI Conference on Human Factors in Computing Systems*, CHI '17, pp. 5016–5028. ACM, New York, NY, USA, 2017. doi: 10.1145/3025453.3025494

[84] R. Gal, L. Shapira, E. Ofek, and P. Kohli. FLARE: Fast layout for augmented reality applications. In *IEEE International Symposium on Mixed and Augmented Reality*, pp. 207–212, 2014.

[85] M. Gandy, R. Catrambone, B. MacIntyre, C. Alvarez, E. Eiriksdottir, M. Hilimire, B. Davidson, and A. C. McLaughlin. Experiences with an AR evaluation test bed: Presence, performance, and physiological measurement. In *IEEE International Symposium on Mixed and Augmented Reality*, pp. 127–136, 2010.

[86] M. Gandy and B. MacIntyre. Designer's augmented reality toolkit, ten years later: Implications for new media authoring tools. In *Proceedings of the 27th Annual ACM Symposium on User Interface Software and Technology*, UIST '14, p. 627–636. Association for Computing Machinery, New York, NY, USA, 2014. doi: 10.1145/2642918.2647369

[87] M. Garon and J. Lalonde. Deep 6-DOF tracking. *Transactions on Visualization and Computer Graphics*, 23(11):2410–2418, 2017.

[88] V. Gaudillière, G. Simon, and M. Berger. Camera relocalization with ellipsoidal abstraction of objects. In *2019 IEEE International Symposium on Mixed and Augmented Reality (ISMAR)*, pp. 8–18, 2019.

[89] S. Gauglitz, B. Nuernberger, M. Turk, and T. Höllerer. World-stabilized annotations and virtual scene navigation for remote collaboration. In *Proceedings of the 27th Annual ACM Symposium on User Interface Software and Technology*, UIST '14, p. 449–459. Association for Computing Machinery, New York, NY, USA, 2014. doi: 10.1145/2642918.2647372

[90] S. Gauglitz, C. Sweeney, J. Ventura, M. Turk, and T. Höllerer. Live tracking and mapping from both general and rotation-only camera motion. In *IEEE International Symposium on Mixed and Augmented Reality*, pp. 13–22, 2012.

[91] C. Gebhardt, B. Hecox, B. van Opheusden, D. Wigdor, J. Hillis, O. Hilliges, and H. Benko. Learning cooperative personalized policies from gaze data. In *Proceedings of the 32nd Annual ACM Symposium on User Interface Software and Technology*, UIST '19, p. 197–208. Association for Computing Machinery, New York, NY, USA, 2019. doi: 10.1145/3332165.3347933

[92] c. Genç, S. Soomro, Y. Duyan, S. Ölçer, F. Balcı, H. Ürey, and O. Özcan. Head mounted projection display & visual attention: Visual attentional processing of head referenced static and dynamic displays while in motion and standing. In *Proceedings of the 2016 CHI Conference on Human Factors in Computing Systems*, CHI '16, pp. 1538–1547. ACM, New York, NY, USA, 2016. doi: 10.1145/2858036.2858449

[93] M. Geronazzo, E. Sikström, J. Kleimola, F. Avanzini, A. de Götzen, and S. Serafin. The impact of an accurate vertical localization with HRTFs on short explorations of immersive virtual reality scenarios. In *IEEE International Symposium on Mixed and Augmented Reality*, pp. 90–97, 2018.

[94] B. Glocker, S. Izadi, J. Shotton, and A. Criminisi. Real-time RGB-D camera relocalization. In *IEEE International Symposium on Mixed and Augmented Reality*, pp. 173–179, 2013.

[95] S. Golodetz, T. Cavallari, N. A. Lord, V. A. Prisacariu, D. W. Murray, and P. H. S. Torr. Collaborative large-scale dense 3D reconstruction with online inter-agent pose optimisation. *Transactions on Visualization and Computer Graphics*, 24(11):2895–2905, 2018.

[96] M. Goto, Y. Uematsu, H. Saito, S. Senda, and A. Iketani. Task support system by displaying instructional video onto AR workspace. In *IEEE International Symposium on Mixed and Augmented Reality*, pp. 83–90, 2010.

[97] J. G. Grandi, H. G. Debarba, I. Bemdt, L. Nedel, and A. Maciel. Design and assessment of a collaborative 3d interaction technique for handheld augmented reality. In *2018 IEEE Conference on Virtual Reality and 3D User Interfaces (VR)*, pp. 49–56, 2018.

[98] R. Grasset, T. Langlotz, D. Kalkofen, M. Tatzgern, and D. Schmalstieg. Image-driven view management for augmented reality browsers. In *IEEE International Symposium on Mixed and Augmented Reality*, pp. 177–186, 2012.

[99] L. Gruber, S. Gauglitz, J. Ventura, S. Zollmann, M. Huber, M. Schlegel, G. Klinker, D. Schmalstieg, and T. Höllerer. The city of sights: Design, construction, and measurement of an augmented reality stage set. In *IEEE International Symposium on Mixed and Augmented Reality*, pp. 157–163, 2010.

[100] L. Gruber, T. Richter-Trummer, and D. Schmalstieg. Real-time photometric registration from arbitrary geometry. In *IEEE International Symposium on Mixed and Augmented Reality*, pp. 119–128, 2012.

[101] L. Gruber, J. Ventura, and D. Schmalstieg. Image-space illumination for augmented reality in dynamic environments. In *2015 IEEE Virtual Reality (VR)*, pp. 127–134, 2015.

[102] J. Grubert, M. Heinisch, A. Quigley, and D. Schmalstieg. Multifi: Multi fidelity interaction with displays on and around the body. In *Proceedings of the 33rd Annual ACM Conference on Human Factors in Computing Systems*, CHI '15, pp. 3933–3942. ACM, New York, NY, USA, 2015. doi: 10. 1145/2702123.2702331

[103] J. Grubert, T. Langlotz, S. Zollmann, and H. Regenbrecht. Towards pervasive augmented reality: Context-awareness in augmented reality. *Transactions on Visualization and Computer Graphics*, 23(6):1706–1724, 2017.

[104] J. Gugenheimer, E. Stemasov, J. Frommel, and E. Rukzio. ShareVR: Enabling co-located experiences for virtual reality between hmd and non-hmd users. In *Proceedings of the 2017 CHI Conference on Human Factors in Computing Systems*, CHI '17, pp. 4021–4033. ACM, New York, NY, USA, 2017. doi: 10.1145/3025453.3025683

[105] J. Gugenheimer, E. Stemasov, H. Sareen, and E. Rukzio. Facedisplay: Towards asymmetric multi-user interaction for nomadic virtual reality. In *Proceedings of the 2018 CHI Conference on Human Factors in Computing Systems*, CHI '18, pp. 54:1–54:13. ACM, New York, NY, USA, 2018. doi: 10. 1145/3173574.3173628

[106] J. Guo, D. Weng, Z. Zhang, H. Jiang, Y. Liu, Y. Wang, and H. B. Duh. Mixed reality office system based on maslow's hierarchy of needs: Towards the long-term immersion in virtual environments. In *2019 IEEE International Symposium on Mixed and Augmented Reality (ISMAR)*, pp. 224–235, 2019.

[107] K. Gupta, G. A. Lee, and M. Billinghurst. Do you see what i see? the effect of gaze tracking on task space remote collaboration. *Transactions on Visualization and Computer Graphics*, 22(11):2413–2422, 2016.

[108] P. Gurevich, J. Lanir, B. Cohen, and R. Stone. Teleadvisor: A versatile augmented reality tool for remote assistance. In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems*, CHI '12, pp. 619–622. ACM, New York, NY, USA, 2012. doi: 10.1145/2207676.2207763

[109] T. Ha, S. Feiner, and W. Woo. WeARHand: Head-worn, RGB-D camera-based, bare-hand user interface with visually enhanced depth perception. In *IEEE International Symposium on Mixed and Augmented Reality*, pp. 219–228, 2014.

[110] S. Habert, J. Gardiazabal, P. Fallavollita, and N. Navab. RGBDX: First design and experimental validation of a mirror-based RGBD x-ray imaging system. In *IEEE International Symposium on Mixed and Augmented Reality*, pp. 13–18, 2015.

[111] N. Hagbi, O. Bergig, J. El-Sana, and M. Billinghurst. Shape recognition and pose estimation for mobile augmented reality. In *IEEE International Symposium on Mixed and Augmented Reality*, pp. 65–71, 2009.

[112] N. Haouchine, J. Dequidt, M. Berger, and S. Cotin. Single view augmentation of 3D elastic objects. In *IEEE International Symposium on Mixed and Augmented Reality*, pp. 229–236, 2014.

[113] N. Haouchine, J. Dequidt, I. Peterlik, E. Kerrien, M. Berger, and S. Cotin. Image-guided simulation of heterogeneous tissue deformation for augmented reality during hepatic surgery. In *IEEE International Symposium on Mixed and Augmented Reality*, pp. 199–208, 2013.

[114] D. Harborth and S. Pape. Exploring the hype: Investigating technology acceptance factors of pokémon go. In *IEEE International Symposium on Mixed and Augmented Reality*, pp. 155–168, 2017.

[115] A. Hartl, J. Grubert, D. Schmalstieg, and G. Reitmayr. Mobile interactive hologram verification. In *IEEE International Symposium on Mixed and Augmented Reality*, pp. 75–82, 2013.

[116] S. Hauswiesner, M. Straka, and G. Reitmayr. Image-based clothes transfer. In *IEEE International Symposium on Mixed and Augmented Reality*, pp. 169–172, 2011.

[117] A. Hazzard, S. Benford, and G. Burnett. Walk this way: Musically guided walking experiences. In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems*, CHI '14, pp. 605–614. ACM, New York, NY, USA, 2014. doi: 10.1145/2556288.2557250

[118] A. K. Hebborn, N. Höhner, and S. Müller. Occlusion matting: Realistic occlusion handling for augmented reality applications. In *IEEE International Symposium on Mixed and Augmented Reality*, pp. 62–71, 2017.

[119] S. J. Henderson and S. Feiner. Evaluating the benefits of augmented reality for task localization in maintenance of an armored personnel carrier turret. In *IEEE International Symposium on Mixed and Augmented Reality*, pp. 135–144, 2009.

[120] S. J. Henderson and S. K. Feiner. Augmented reality in the psychomotor phase of a procedural task. In *IEEE International Symposium on Mixed and Augmented Reality*, pp. 191–200, 2011.

[121] J. Herling and W. Broll. Advanced self-contained object removal for realizing real-time diminished reality in unconstrained environments. In *IEEE International Symposium on Mixed and Augmented Reality*, pp. 207–212, 2010.

[122] J. Herling and W. Broll. Pixmix: A real-time approach to high-quality diminished reality. In *IEEE International Symposium on Mixed and Augmented Reality*, pp. 141–150, 2012.

[123] A. Hettiarachchi and D. Wigdor. Annexing reality: Enabling opportunistic use of everyday objects as tangible proxies in augmented reality. In *Proceedings of the 2016 CHI Conference on Human Factors in Computing Systems*, CHI '16, pp. 1957–1967. ACM, New York, NY, USA, 2016. doi: 10.1145/2858036 .2858134

[124] O. Hilliges, D. Kim, S. Izadi, M. Weiss, and A. Wilson. Holodesk: Direct 3d interactions with a situated see-through display. In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems*, CHI '12, pp. 2421–2430. ACM, New York, NY, USA, 2012. doi: 10.1145/2207676. 2208405

[125] Y. Hirano, A. Kimura, F. Shibata, and H. Tamura. Psychophysical influence of mixed-reality visual stimulation on sense of hardness. In *2011 IEEE Virtual Reality Conference*, pp. 51–54, 2011.

[126] T. Hoang, M. Reinoso, Z. Joukhadar, F. Vetere, and D. Kelly. Augmented studio: Projection mapping on moving body for physiotherapy education. In *Proceedings of the 2017 CHI Conference on Human Factors in Computing Systems*, CHI '17, pp. 1419–1430. ACM, New York, NY, USA, 2017. doi: 10. 1145/3025453.3025860

[127] G. Hough, I. Williams, and C. Athwal. Measurements of live actor motion in mixed reality interaction. In *IEEE International Symposium on Mixed and Augmented Reality*, pp. 99–104, 2014.

[128] K. Huo, T. Wang, L. Paredes, A. M. Villanueva, Y. Cao, and K. Ramani. Synchronizar: Instant synchronization for spontaneous and spatial collaborations in augmented reality. In *Proceedings of the 31st Annual ACM Symposium on User Interface Software and Technology*, UIST '18, p. 19–30. Association for Computing Machinery, New York, NY, USA, 2018. doi: 10.1145/3242587.3242595

[129] B. Huynh, J. Orlosky, and T. Höllerer. In-situ labeling for augmented reality language learning. In *2019 IEEE Conference on Virtual Reality and 3D User Interfaces (VR)*, pp. 1606–1611, 2019.

[130] A. Ibrahim, B. Huynh, J. Downey, T. Höllerer, D. Chun, and J. O'donovan. ARbis pictus: A study of vocabulary learning with augmented reality. *Transactions on Visualization and Computer Graphics*, 24(11):2867–2874, 2018.

[131] A. Ishii, I. Suzuki, S. Sakamoto, K. Kanai, K. Takazawa, H. Doi, and Y. Ochiai. Optical marionette: Graphical manipulation of human's walking direction. In *Proceedings of the 29th Annual Symposium on User Interface Software and Technology*, UIST '16, p. 705–716. Association for Computing Machinery, New York, NY, USA, 2016. doi: 10.1145/2984511.2984545

[132] P. Issartel, F. Guéniat, S. Coquillart, and M. Ammi. Perceiving mass in mixed reality through pseudo-haptic rendering of newton's third law. In *2015 IEEE Virtual Reality (VR)*, pp. 41–46, 2015.

[133] E. Ito, T. Okatani, and K. Deguchi. Accurate and robust planar tracking based on a model of image sampling and reconstruction process. In *IEEE International Symposium on Mixed and Augmented Reality*, pp. 1–8, 2011.

[134] Y. Itoh, T. Amano, D. Iwai, and G. Klinker. Gaussian light field: Estimation of viewpoint-dependent blur for optical see-through head-mounted displays. *Transactions on Visualization and Computer Graphics*, 22(11):2368–2376, 2016.

[135] Y. Itoh, M. Dzitsiuk, T. Amano, and G. Klinker. Semi-parametric color reproduction method for optical see-through head-mounted displays. *Transactions on Visualization and Computer Graphics*, 21(11):1269–1278, 2015.

[136] Y. Itoh, T. Hamasaki, and M. Sugimoto. Occlusion leak compensation for optical see-through displays using a single-layer transmissive spatial light modulator. *Transactions on Visualization and Computer Graphics*, 23(11):2463–2473, 2017.

[137] Y. Itoh and G. Klinker. Performance and sensitivity analysis of INDICA: Interaction-free display calibration for optical see-through head-mounted displays. In *IEEE International Symposium on Mixed and Augmented Reality*, pp. 171–176, 2014.

[138] Y. Itoh and G. Klinker. Simultaneous direct and augmented view distortion calibration of optical see-through head-mounted displays. In *IEEE International Symposium on Mixed and Augmented Reality*, pp. 43–48, 2015.

[139] J. Jachnik, R. A. Newcombe, and A. J. Davison. Real-time surface light-field capture for augmentation of planar specular surfaces. In *IEEE International Symposium on Mixed and Augmented Reality*, pp. 91–97, 2012.

[140] B. R. Jones, H. Benko, E. Ofek, and A. D. Wilson. Illumiroom: Peripheral projected illusions for interactive experiences. In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems*, CHI '13, pp. 869–878. ACM, New York, NY, USA, 2013. doi: 10.1145/2470654.2466112

[141] B. R. Jones, R. Sodhi, R. H. Campbell, G. Garnett, and B. P. Bailey. Build your world and play in it: Interacting with surface particles on complex objects. In *IEEE International Symposium on Mixed and Augmented Reality*, pp. 165–174, 2010.

[142] J. Jung, H. Lee, J. Choi, A. Nanda, U. Gruenefeld, T. Stratmann, and W. Heuten. Ensuring safety in augmented reality from trade-off between immersion and situation awareness. In *IEEE International Symposium on Mixed and Augmented Reality*, pp. 70–79, 2018.

[143] H. Kajita, N. Koizumi, and T. Naemura. Skyanchor: Optical design for anchoring mid-air images onto physical objects. In *Proceedings of the 29th Annual Symposium on User Interface Software and Technology*, UIST '16, p. 415–423. Association for Computing Machinery, New York, NY, USA, 2016. doi: 10.1145/2984511.2984589

[144] M. Kalia, N. Navab, S. Fels, and T. Salcudean. A method to introduce evaluate motion parallax with stereo for medical ar/mr. In *2019 IEEE Conference on Virtual Reality and 3D User Interfaces (VR)*, pp. 1755–1759, 2019.

[145] D. Kalkofen, E. Veas, S. Zollmann, M. Steinberger, and D. Schmalstieg. Adaptive ghosted views for augmented reality. In *IEEE International Symposium on Mixed and Augmented Reality*, pp. 1–9, 2013.

[146] T. Kaminokado, D. Iwai, and K. Sato. Augmented environment mapping for appearance editing of glossy surfaces. In *2019 IEEE International Symposium on Mixed and Augmented Reality (ISMAR)*, pp. 55–65, 2019.

[147] K. Kanamori, N. Sakata, T. Tominaga, Y. Hijikata, K. Harada, and K. Kiyokawa. Obstacle avoidance method in real space for virtual reality immersion. In *IEEE International Symposium on Mixed and Augmented Reality*, pp. 80–89, 2018.

[148] J. Karlekar, S. Z. Zhou, W. Lu, Z. C. Loh, Y. Nakayama, and D. Hii. Positioning, tracking and mapping for outdoor augmentation. In *IEEE International Symposium on Mixed and Augmented Reality*, pp. 175–184, 2010.

[149] A. Karnik, W. Mayol-Cuevas, and S. Subramanian. Mustard: A multi user see through ar display. In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems*, CHI '12, pp. 2541–2550. ACM, New York, NY, USA, 2012. doi: 10.1145/2207676.2208641

[150] P. Keitler, B. Becker, and G. Klinker. Management of tracking for industrial AR setups. In *IEEE International Symposium on Mixed and Augmented Reality*, pp. 73–82, 2010.

[151] R. Khadka and A. Banic. Body-prop interaction: Evaluation of augmented open discs and egocentric body-based interaction. In *2019 IEEE Conference on Virtual Reality and 3D User Interfaces (VR)*, pp. 1705–1710, 2019.

[152] B. M. Khuong, K. Kiyokawa, A. Miller, J. J. La Viola, T. Mashita, and H. Takemura. The effectiveness of an ar-based context-aware assembly support system in object assembly. In *2014 IEEE Virtual Reality (VR)*, pp. 57–62, 2014.

[153] H. Kim, M. Kim, and W. Lee. Hapthimble: A wearable haptic device towards usable virtual touch screen. In *Proceedings of the 2016 CHI Conference on Human Factors in Computing Systems*, CHI '16, pp. 3694–3705. ACM, New York, NY, USA, 2016. doi: 10.1145/2858036.2858196

[154] K. Kim, M. Billinghurst, G. Bruder, H. B. Duh, and G. F. Welch. Revisiting trends in augmented reality research: A review of the 2nd decade of ISMAR (2008—2017). *Transactions on Visualization and Computer Graphics*, 24(11):2947–2962, 2018.

[155] K. Kim, L. Boelling, S. Haesler, J. Bailenson, G. Bruder, and G. F. Welch. Does a digital assistant need a body? the influence of visual embodiment and social behavior on the perception of intelligent virtual agents in AR. In *IEEE International Symposium on Mixed and Augmented Reality*, pp. 105–114, 2018.

[156] K. Kim, V. Lepetit, and W. Woo. Keyframe-based modeling and tracking of multiple 3D objects. In *IEEE International Symposium on Mixed and Augmented Reality*, pp. 193–198, 2010.

[157] K. Kim, S. Oh, J. Lee, and I. Essa. Augmenting aerial earth maps with dynamic information. In *IEEE International Symposium on Mixed and Augmented Reality*, pp. 35–38, 2009.

[158] S. Kim and A. K. Dey. Simulated augmented reality windshield display as a cognitive mapping aid for elder driver navigation. In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems*, CHI '09, pp. 133–142. ACM, New York, NY, USA, 2009. doi: 10.1145/1518701.1518724

[159] S. Kim, G. Lee, W. Huang, H. Kim, W. Woo, and M. Billinghurst. Evaluating the combination of visual communication cues for hmd-based mixed reality remote collaboration. In *Proceedings of the 2019 CHI Conference on Human Factors in Computing Systems*, CHI '19, p. 1–13. Association for Computing Machinery, New York, NY, USA, 2019. doi: 10.1145/3290605.3300403

[160] S. Kim, G. Lee, N. Sakata, and M. Billinghurst. Improving co-presence with augmented visual communication cues for sharing experience through video conference. In *IEEE International Symposium on Mixed and Augmented Reality*, pp. 83–92, 2014.

[161] Y. Kim, H. Park, S. Bang, and S. Lee. Retargeting human-object interaction to virtual avatars. *Transactions on Visualization and Computer Graphics*, 22(11):2405–2412, 2016.

[162] N. Kishishita, K. Kiyokawa, J. Orlosky, T. Mashita, H. Takemura, and E. Kruijff. Analysing the effects of a wide field of view augmented reality display on search performance in divided attention tasks. In *IEEE International Symposium on Mixed and Augmented Reality*, pp. 177–186, 2014.

[163] Y. Kitajima, D. Iwai, and K. Sato. Simultaneous projection and positioning of laser projector pixels. *Transactions on Visualization and Computer Graphics*, 23(11):2419–2429, 2017.

[164] G. Klein and D. Murray. Parallel tracking and mapping on a camera phone. In *IEEE International Symposium on Mixed and Augmented Reality*, pp. 83–86, 2009.

[165] M. Kljun, K. v. Pucihar, J. Alexander, M. Weerasinghe, C. Campos, J. Ducasse, B. Kopacin, J. Grubert, P. Coulton, and M. Čelar. Augmentation not duplication: Considerations for the design of digitally-augmented comic books. In *Proceedings of the 2019 CHI Conference on Human Factors in Computing Systems*, CHI '19, p. 1–12. Association for Computing Machinery, New York, NY, USA, 2019. doi: 10.1145/3290605.3300333

[166] M. Knecht, C. Traxler, O. Mattausch, W. Purgathofer, and M. Wimmer. Differential instant radiosity for mixed reality. In *IEEE International Symposium on Mixed and Augmented Reality*, pp. 99–107, 2010.

[167] M. Knecht, C. Traxler, W. Purgathofer, and M. Wimmer. Adaptive camera-based color mapping for mixed-reality applications. In *IEEE International Symposium on Mixed and Augmented Reality*, pp. 165–168, 2011.

[168] B. Knorlein, M. Di Luca, and M. Harders. Influence of visual and haptic delays on stiffness perception in augmented reality. In *IEEE International Symposium on Mixed and Augmented Reality*, pp. 49–52, 2009.

[169] S. B. Knorr and D. Kurz. Real-time illumination estimation from faces for coherent rendering. In *IEEE International Symposium on Mixed and Augmented Reality*, pp. 113–122, 2014.

[170] S. B. Knorr and D. Kurz. Leveraging the user's face for absolute scale estimation in handheld monocular SLAM. In *IEEE International Symposium on Mixed and Augmented Reality*, pp. 11–17, 2016.

[171] H. Koike, W. Nishikawa, and K. Fukuchi. Transparent 2-d markers on an lcd tabletop system. In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems*, CHI '09, pp. 163–172. ACM, New York, NY, USA, 2009. doi: 10.1145/1518701.1518728

[172] B. Koleva, S. R. Egglestone, H. Schnädelbach, K. Glover, C. Greenhalgh, T. Rodden, and M. Dade-Robertson. Supporting the creation of hybrid museum experiences. In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems*, CHI '09, pp. 1973–1982. ACM, New York, NY, USA, 2009. doi: 10.1145/1518701.1519001

[173] A. Kotranza, D. Scott Lind, C. M. Pugh, and B. Lok. Real-time in-situ visual feedback of task performance in mixed environments for learning joint psychomotor-cognitive tasks. In *IEEE International Symposium on Mixed and Augmented Reality*, pp. 125–134, 2009.

[174] M. E. Kouzi, A. Mao, and D. Zambrano. An educational augmented reality application for elementary school students focusing on the human skeletal system. In *2019 IEEE Conference on Virtual Reality and 3D User Interfaces (VR)*, pp. 1594–1599, 2019.

[175] M. Krichenbauer, G. Yamamoto, T. Taketomi, C. Sandor, and H. Kato. Towards augmented reality user interfaces in 3D media production. In *IEEE International Symposium on Mixed and Augmented Reality*, pp. 23–28, 2014.

[176] E. Kruijff, J. E. Swan, and S. Feiner. Perceptual issues in augmented reality revisited. In *IEEE International Symposium on Mixed and Augmented Reality*, pp. 3–12, 2010.

[177] P. Ku, Y. Lin, Y. Peng, and M. Y. Chen. Peritext: Utilizing peripheral vision for reading text on augmented reality smart glasses. In *2019 IEEE Conference on Virtual Reality and 3D User Interfaces (VR)*, pp. 630–635, 2019.

[178] C. Kunert, T. Schwandt, and W. Broll. Efficient point cloud rasterization for real time volumetric integration in mixed reality applications. In *IEEE International Symposium on Mixed and Augmented Reality*, pp. 1–9, 2018.

[179] P. Kurth, V. Lange, C. Siegl, M. Stamminger, and F. Bauer. Auto-calibration for dynamic multi-projection mapping on arbitrary surfaces. *Transactions on Visualization and Computer Graphics*, 24(11):2886–2894, 2018.

[180] D. Kurz. Thermal touch: Thermography-enabled everywhere touch interfaces for mobile augmented reality applications. In *IEEE International Symposium on Mixed and Augmented Reality*, pp. 9–16, 2014.

[181] D. Kurz and S. Benhimane. Gravity-aware handheld augmented reality. In *IEEE International Symposium on Mixed and Augmented Reality*, pp. 111–120, 2011.

[182] D. Kurz, T. Olszamowski, and S. Benhimane. Representative feature descriptor sets for robust handheld camera localization. In *IEEE International Symposium on Mixed and Augmented Reality*, pp. 65–70, 2012.

[183] K. C. Kwan and H. Fu. Mobi3dsketch: 3d sketching in mobile ar. In *Proceedings of the 2019 CHI Conference on Human Factors in Computing Systems*, CHI '19, p. 1–11. Association for Computing Machinery, New York, NY, USA, 2019. doi: 10.1145/3290605.3300406

[184] M. Kytö, B. Ens, T. Piumsomboon, G. A. Lee, and M. Billinghurst. Pinpointing: Precise head- and eye-based target selection for augmented reality. In *Proceedings of the 2018 CHI Conference on Human Factors in Computing Systems*, CHI '18, pp. 81:1–81:14. ACM, New York, NY, USA, 2018. doi: 10.1145/3173574.3173655

[185] M. Kytö, K. Kusumoto, and P. Oittinen. The ventriloquist effect in augmented reality. In *IEEE International Symposium on Mixed and Augmented Reality*, pp. 49–53, 2015.

[186] P. Kán and H. Kaufmann. High-quality reflections, refractions, and caustics in augmented reality and their contribution to visual coherence. In *IEEE International Symposium on Mixed and Augmented Reality*, pp. 99–108, 2012.

[187] P. Kán and H. Kaufmann. Differential irradiance caching for fast high-quality light transport between virtual and real worlds. In *IEEE International Symposium on Mixed and Augmented Reality*, pp. 133–141, 2013.

[188] O. Kähler, V. Adrian Prisacariu, C. Yuheng Ren, X. Sun, P. Torr, and D. Murray. Very high frame rate volumetric integration of depth images on mobile devices. *Transactions on Visualization and Computer Graphics*, 21(11):1241–1250, 2015.

[189] K. S. Ladefoged and C. B. Madsen. Spatially-varying diffuse reflectance capture using irradiance map rendering for image-based modeling applications. In *2019 IEEE International Symposium on Mixed and Augmented Reality (ISMAR)*, pp. 46–54, 2019.

[190] W. Lages, Y. Li, L. Lisle, T. Höllerer, and D. Bowman. Enhanced geometric techniques for point marking in model-free augmented reality. In *2019 IEEE International Symposium on Mixed and Augmented Reality (ISMAR)*, pp. 301–309, 2019.

[191] Y. Lang, W. Liang, and L. Yu. Virtual agent positioning driven by scene semantics in mixed reality. In *2019 IEEE Conference on Virtual Reality and 3D User Interfaces (VR)*, pp. 767–775, 2019.

[192] T. Langlotz, M. Cook, and H. Regenbrecht. Real-time radiometric compensation for optical see-through head-mounted displays. *Transactions on Visualization and Computer Graphics*, 22(11):2385–2394, 2016.

[193] G. A. Lee, T. Teo, S. Kim, and M. Billinghurst. A user study on MR remote collaboration using live 360 video. In *IEEE International Symposium on Mixed and Augmented Reality*, pp. 153–164, 2018.

[194] J. H. Lee, S.-G. An, Y. Kim, and S.-H. Bae. Projective windows: Bringing windows in space to the fingertip. In *Proceedings of the 2018 CHI Conference on Human Factors in Computing Systems*, CHI '18, pp. 218:1–218:8. ACM, New York, NY, USA, 2018. doi: 10.1145/3173574.3173792

[195] M. Lee, K. Kim, S. Daher, A. Raij, R. Schubert, J. Bailenson, and G. Welch. The wobbly table: Increased social presence via subtle incidental movement of a real-virtual table. In *2016 IEEE Virtual Reality (VR)*, pp. 11–17, 2016.

[196] W. Lee, Y. Park, V. Lepetit, and W. Woo. Point-and-shoot for ubiquitous tagging on mobile phones. In *IEEE International Symposium on Mixed and Augmented Reality*, pp. 57–64, 2010.

[197] N. H. Lehment, D. Merget, and G. Rigoll. Creating automatically aligned consensus realities for AR videoconferencing. In *IEEE International Symposium on Mixed and Augmented Reality*, pp. 201–206, 2014.

[198] I. Leizea, H. Álvarez, I. Aguinaga, and D. Borro. Real-time deformation, registration and tracking of solids based on physical simulation. In *IEEE International Symposium on Mixed and Augmented Reality*, pp. 165–170, 2014.

[199] P. Lensing and W. Broll. Instant indirect illumination for dynamic mixed reality scenes. In *IEEE International Symposium on Mixed and Augmented Reality*, pp. 109–118, 2012.

[200] P. Li, T. Qin, B. Hu, F. Zhu, and S. Shen. Monocular visual-inertial state estimation for mobile augmented reality. In *IEEE International Symposium on Mixed and Augmented Reality*, pp. 11–21, 2017.

[201] Z. Li, M. Annett, K. Hinckley, K. Singh, and D. Wigdor. Holodoc: Enabling mixed reality workspaces that harness physical and digital content. In *Proceedings of the 2019 CHI Conference on Human Factors in Computing Systems*, CHI '19, p. 1–14. Association for Computing Machinery, New York, NY, USA, 2019. doi: 10.1145/3290605.3300917

[202] Z. Li, Y. Wang, J. Guo, L.-F. Cheong, and S. Z. Zhou. Diminished reality using appearance and 3D geometry of internet photo collections. In *IEEE International Symposium on Mixed and Augmented Reality*, pp. 11–19, 2013.

[203] S. Lieberknecht, S. Benhimane, P. Meier, and N. Navab. A dataset and evaluation methodology for template-based tracking algorithms. In *IEEE International Symposium on Mixed and Augmented Reality*, pp. 145–151, 2009.

[204] S. Lieberknecht, A. Huber, S. Ilic, and S. Benhimane. RGB-D camera-based parallel tracking and meshing. In *IEEE International Symposium on Mixed and Augmented Reality*, pp. 147–155, 2011.

[205] K. Lien, B. Nuernberger, T. Höllerer, and M. Turk. PPV: Pixel-point-volume segmentation for object referencing in collaborative augmented reality. In *IEEE International Symposium on Mixed and Augmented Reality*, pp. 77–83, 2016.

[206] K. Lilija, H. Pohl, S. Boring, and K. Hornbæk. Augmented reality views for occluded interaction. In *Proceedings of the 2019 CHI Conference on Human Factors in Computing Systems*, CHI '19, p. 1–12. Association for Computing Machinery, New York, NY, USA, 2019. doi: 10.1145/3290605.3300676

[207] D. Lindlbauer. Optically dynamic interfaces. In *Adjunct Publication of the 30th Annual ACM Symposium on User Interface Software and Technology*, UIST '17, p. 107–110. Association for Computing Machinery, New York, NY, USA, 2017. doi: 10.1145/3131785.3131840

[208] D. Lindlbauer, A. M. Feit, and O. Hilliges. Context-aware online adaptation of mixed reality interfaces. In *Proceedings of the 32nd Annual ACM Symposium on User Interface Software and Technology*, UIST '19, p. 147–160. Association for Computing Machinery, New York, NY, USA, 2019. doi: 10.1145/3332165.3347945

[209] D. Lindlbauer, J. Mueller, and M. Alexa. Changing the appearance of real-world objects by modifying their surroundings. In *Proceedings of the 2017 CHI Conference on Human Factors in Computing Systems*, CHI '17, pp. 3954–3965. ACM, New York, NY, USA, 2017. doi: 10.1145/3025453.3025795

[210] C. Liu, S. Huot, J. Diehl, W. Mackay, and M. Beaudouin-Lafon. Evaluating the benefits of real-time feedback in mobile augmented reality with hand-held devices. In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems*, CHI '12, pp. 2973–2976. ACM, New York, NY, USA, 2012. doi: 10.1145/2207676.2208706

[211] C. Liu, A. Plopski, K. Kiyokawa, P. Ratsamee, and J. Orlosky. IntelliPupil: Pupillometric light modulation for optical see-through head-mounted displays. In *IEEE International Symposium on Mixed and Augmented Reality*, pp. 98–104, 2018.

[212] H. Liu, G. Zhang, and H. Bao. Robust keyframe-based monocular SLAM for augmented reality. In *IEEE International Symposium on Mixed and Augmented Reality*, pp. 1–10, 2016.

[213] R. Liu, J. Zhang, S. Chen, and C. Arth. Towards slam-based outdoor localization using poor gps and 2.5d building models. In *2019 IEEE International Symposium on Mixed and Augmented Reality (ISMAR)*, pp. 1–7, 2019.

[214] M. A. Livingston, Z. Ai, and J. W. Decker. A user study towards understanding stereo perception in head-worn augmented reality displays. In *IEEE International Symposium on Mixed and Augmented Reality*, pp. 53–56, 2009.

[215] M. A. Livingston, J. H. Barrow, and C. M. Sibley. Quantification of contrast sensitivity and color perception using head-worn augmented reality displays. In *2009 IEEE Virtual Reality Conference*, pp. 115–122, 2009.

[216] P. Lopes, S. You, A. Ion, and P. Baudisch. Adding force feedback to mixed reality experiences and games using electrical muscle stimulation. In *Proceedings of the 2018 CHI Conference on Human Factors in Computing Systems*, CHI '18, pp. 446:1–446:13. ACM, New York, NY, USA, 2018. doi: 10.1145/3173574.3174020

[217] B. V. Lu, T. Kakuta, R. Kawakami, T. Oishi, and K. Ikeuchi. Foreground and shadow occlusion handling for outdoor augmented reality. In *IEEE International Symposium on Mixed and Augmented Reality*, pp. 109–118, 2010.

[218] F. Lu, D. Yu, H. Liang, W. Chen, K. Papangelis, and N. M. Ali. Evaluating engagement level and analytical support of interactive visualizations in virtual reality environments. In *IEEE International Symposium on Mixed and Augmented Reality*, pp. 143–152, 2018.

[219] W. Lu, B. H. Duh, and S. Feiner. Subtle cueing for visual search in augmented reality. In *IEEE International Symposium on Mixed and Augmented Reality*, pp. 161–166, 2012.

[220] P. Luff, N. Yamashita, H. Kuzuoka, and C. Heath. Hands on hitchcock: Embodied reference to a moving scene. In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems*, CHI '11, pp. 43–52. ACM, New York, NY, USA, 2011. doi: 10.1145/1978942.1978951

[221] X. Luo, J. Lawrence, and S. M. Seitz. Pepper's cone: An inexpensive do-it-yourself 3d display. In *Proceedings of the 30th Annual ACM Symposium on User Interface Software and Technology*, UIST '17, p. 623–633. Association for Computing Machinery, New York, NY, USA, 2017. doi: 10.1145/3126594.3126602

[222] S. Magnenat, D. T. Ngo, F. Zünd, M. Ryffel, G. Noris, G. Rothlin, A. Marra, M. Nitti, P. Fua, M. Gross, and R. W. Sumner. Live texturing of augmented reality characters from colored drawings. *Transactions on Visualization and Computer Graphics*, 21(11):1201–1210, 2015.

[223] T. Mahmood, W. Fulmer, N. Mungoli, J. Huang, and A. Lu. Improving information sharing and collaborative analysis for remote geospatial visualization using mixed reality. In *2019 IEEE International Symposium on Mixed and Augmented Reality (ISMAR)*, pp. 236–247, 2019.

[224] A. Maimone and H. Fuchs. Encumbrance-free telepresence system with real-time 3D capture and display using commodity depth cameras. In *IEEE International Symposium on Mixed and Augmented Reality*, pp. 137–146, 2011.

[225] A. Maimone and H. Fuchs. Computational augmented reality eyeglasses. In *IEEE International Symposium on Mixed and Augmented Reality*, pp. 29–38, 2013.

[226] L. Malinverni, J. Maya, M.-M. Schaper, and N. Pares. The world-as-support: Embodied exploration, understanding and meaning-making of the augmented world. In *Proceedings of the 2017 CHI Conference on Human Factors in Computing Systems*, CHI '17, pp. 5132–5144. ACM, New York, NY, USA, 2017. doi: 10.1145/3025453.3025955

[227] D. Mandl, K. M. Yi, P. Mohr, P. M. Roth, P. Fua, V. Lepetit, D. Schmalstieg, and D. Kalkofen. Learning lightprobes for mixed reality illumination. In *IEEE International Symposium on Mixed and Augmented Reality*, pp. 82–89, 2017.

[228] G. Marentakis and R. Liepins. Evaluation of hear-through sound localization. In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems*, CHI '14, pp. 267–270. ACM, New York, NY, USA, 2014. doi: 10.1145/2556288.2557168

[229] M. R. Marner, A. Irlitti, and B. H. Thomas. Improving procedural task performance with augmented reality annotations. In *IEEE International Symposium on Mixed and Augmented Reality*, pp. 39–48, 2013.

[230] A. Marquardt, C. Trepkowski, T. D. Eibich, J. Maiero, and E. Kruijff. Non-visual cues for view management in narrow field of view augmented reality displays. In *2019 IEEE International Symposium on Mixed and Augmented Reality (ISMAR)*, pp. 190–201, 2019.

[231] S. Martedi, H. Uchiyama, G. Enriquez, H. Saito, T. Miyashita, and T. Hara. Foldable augmented maps. In *IEEE International Symposium on Mixed and Augmented Reality*, pp. 65–72, 2010.

[232] A. L. Martin-Niedecken, K. Rogers, L. Turmo Vidal, E. D. Mekler, and E. Márquez Segura. Exercube vs. personal trainer: Evaluating a holistic, immersive, and adaptive fitness game setup. In *Proceedings of the 2019 CHI Conference on Human Factors in Computing Systems*, CHI '19, p. 1–15. Association for Computing Machinery, New York, NY, USA, 2019. doi: 10.1145/3290605.3300318

[233] D. Martinez Plasencia, F. Berthaut, A. Karnik, and S. Subramanian. Through the combining glass. In *Proceedings of the 27th Annual ACM Symposium on User Interface Software and Technology*, UIST '14, p. 341–350. Association for Computing Machinery, New York, NY, USA, 2014. doi: 10.1145/2642918.2647351

[234] C. McCarthy and N. Barnes. Importance weighted image enhancement for prosthetic vision: An augmentation framework. In *IEEE International Symposium on Mixed and Augmented Reality*, pp. 45–51, 2014.

[235] D. K. McGookin, S. A. Brewster, and G. Christov. Studying digital graffiti as a location-based social network. In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems*, CHI '14, pp. 3269–3278. ACM, New York, NY, USA, 2014. doi: 10.1145/2556288.2557266

[236] P. McIlroy, S. Izadi, and A. Fitzgibbon. Kinectrack: Agile 6-DoF tracking using a projected dot pattern. In *IEEE International Symposium on Mixed and Augmented Reality*, pp. 23–29, 2012.

[237] M. Meilland, C. Barat, and A. Comport. 3D high dynamic range dense visual SLAM and its application to real-time object re-lighting. In *IEEE International Symposium on Mixed and Augmented Reality*, pp. 143–152, 2013.

[238] A. Meka, G. Fox, M. Zollhöfer, C. Richardt, and C. Theobalt. Live user-guided intrinsic video for static scenes. *Transactions on Visualization and Computer Graphics*, 23(11):2447–2454, 2017.

[239] C. Menk and R. Koch. Interactive visualization technique for truthful color reproduction in spatial augmented reality applications. In *IEEE International Symposium on Mixed and Augmented Reality*, pp. 157–164, 2011.

[240] C. Merenda, H. Kim, K. Tanous, J. L. Gabbard, B. Feichtl, T. Misu, and C. Suga. Augmented reality interface design approaches for goal-directed and stimulus-driven driving tasks. *Transactions on Visualization and Computer Graphics*, 24(11):2875–2885, 2018.

[241] C. Merenda, C. Suga, J. L. Gabbard, and T. Misu. Effects of "real-world" visual fidelity on ar interface assessment: A case study using ar head-up display graphics in driving. In *2019 IEEE International Symposium on Mixed and Augmented Reality (ISMAR)*, pp. 145–156, 2019.

[242] A. Meshram, R. Mehra, H. Yang, E. Dunn, J. Franm, and D. Manocha. P-HRTF: Efficient personalized HRTF computation for high-fidelity spatial sound. In *IEEE International Symposium on Mixed and Augmented Reality*, pp. 53–61, 2014.

[243] N. A. Miedema, J. Vermeer, S. Lukosch, and R. Bidarra. Superhuman sports in mixed reality: The multi-player game league of lasers. In *2019 IEEE Conference on Virtual Reality and 3D User Interfaces (VR)*, pp. 1819–1825, 2019.

[244] P. Mohr, B. Kerbl, M. Donoser, D. Schmalstieg, and D. Kalkofen. Retargeting technical documentation to augmented reality. In *Proceedings of the 33rd Annual ACM Conference on Human Factors in Computing Systems*, CHI '15, pp. 3337–3346. ACM, New York, NY, USA, 2015. doi: 10.1145/2702123.2702490

[245] P. Mohr, M. Tatzgern, T. Langlotz, A. Lang, D. Schmalstieg, and D. Kalkofen. Trackcap: Enabling smartphones for 3d interaction on mobile head-mounted displays. In *Proceedings of the 2019 CHI Conference on Human Factors in Computing Systems*, CHI '19, p. 1–11. Association for Computing Machinery, New York, NY, USA, 2019. doi: 10.1145/3290605.3300815

[246] A. Moore, M. Kodeih, A. Singhania, A. Wu, T. Bashir, and R. McMahan. The importance of intersection disambiguation for virtual hand techniques. In *2019 IEEE International Symposium on Mixed and Augmented Reality (ISMAR)*, pp. 310–317, 2019.

[247] A. Morgand, M. Tamaazousti, and A. Bartoli. An empirical model for specularity prediction with application to dynamic retexturing. In *IEEE International Symposium on Mixed and Augmented Reality*, pp. 44–53, 2016.

[248] A. Morgand, M. Tamaazousti, and A. Bartoli. A multiple-view geometric model of specularities on non-planar shapes with application to dynamic retexturing. *Transactions on Visualization and Computer Graphics*, 23(11):2485–2493, 2017.

[249] S. Mori, S. Ikeda, A. Plopski, and C. Sandor. Brightview: Increasing perceived brightness of optical see-through head-mounted displays through unnoticeable incident light reduction. In *2018 IEEE Conference on Virtual Reality and 3D User Interfaces (VR)*, pp. 251–258, 2018.

[250] K. R. Moser, M. S. Arefin, and J. E. Swan. Impact of alignment point distance and posture on SPAAM calibration of optical see-through head-mounted displays. In *IEEE International Symposium on Mixed and Augmented Reality*, pp. 21–30, 2018.

[251] F. Mostajeran, N. Katzakis, O. Ariza, J. P. Freiwald, and F. Steinicke. Welcoming a holographic virtual coach for balance training at home: Two focus groups with older adults. In *2019 IEEE Conference on Virtual Reality and 3D User Interfaces (VR)*, pp. 1465–1470, 2019.

[252] F. Müller, J. McManus, S. Günther, M. Schmitz, M. Mühlhäuser, and M. Funk. Mind the tap: Assessing foot-taps for interacting with head-mounted displays. In *Proceedings of the 2019 CHI Conference on Human Factors in Computing Systems*, CHI '19, p. 1–13. Association for Computing Machinery, New York, NY, USA, 2019. doi: 10.1145/3290605.3300707

[253] J. Müller, R. Rädle, and H. Reiterer. Virtual objects as spatial cues in collaborative mixed reality environments: How they shape communication behavior and user task load. In *Proceedings of the 2016 CHI Conference on Human Factors in Computing Systems*, CHI '16, pp. 1245–1249. ACM, New York, NY, USA, 2016. doi: 10.1145/2858036.2858043

[254] J. Müller, R. Rädle, and H. Reiterer. Remote collaboration with mixed reality displays: How shared virtual landmarks facilitate spatial referencing. In *Proceedings of the 2017 CHI Conference on Human Factors in Computing Systems*, CHI '17, pp. 6481–6486. ACM, New York, NY, USA, 2017. doi: 10.1145/3025453.3025717

[255] A. Mulloni, M. Ramachandran, G. Reitmayr, D. Wagner, R. Grasset, and S. Diaz. User friendly SLAM initialization. In *IEEE International Symposium on Mixed and Augmented Reality*, pp. 153–162, 2013.

[256] C. Müller, M. Braun, and T. Ertl. Optimised molecular graphics on the hololens. In *2019 IEEE Conference on Virtual Reality and 3D User Interfaces (VR)*, pp. 97–102, 2019.

[257] K. Nakano, D. Horita, N. Sakata, K. Kiyokawa, K. Yanai, and T. Narumi. Deeptaste: Augmented reality gustatory manipulation with gan-based real-time food-to-food translation. In *2019 IEEE International Symposium on Mixed and Augmented Reality (ISMAR)*, pp. 212–223, 2019.

[258] T. Narumi, S. Nishizaka, T. Kajinami, T. Tanikawa, and M. Hirose. Augmented reality flavors: Gustatory display based on edible marker and cross-modal interaction. In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems*, CHI '11, pp. 93–102. ACM, New York, NY, USA, 2011. doi: 10.1145/1978942.1978957

[259] M. Nebeling, J. Nebeling, A. Yu, and R. Rumble. Protoar: Rapid physical-digital prototyping of mobile augmented reality applications. In *Proceedings of the 2018 CHI Conference on Human Factors in Computing Systems*, CHI '18, pp. 353:1–353:12. ACM, New York, NY, USA, 2018. doi: 10.1145/3173574.3173927

[260] R. A. Newcombe, S. Izadi, O. Hilliges, D. Molyneaux, D. Kim, A. J. Davison, P. Kohi, J. Shotton, S. Hodges, and A. Fitzgibbon. KinectFusion: Real-time dense surface mapping and tracking. In *IEEE International Symposium on Mixed and Augmented Reality*, pp. 127–136, 2011.

[261] T. Nguyen, R. Grasset, D. Schmalstieg, and G. Reitmayr. Interactive syntactic modeling with a single-point laser range finder and camera. In *IEEE International Symposium on Mixed and Augmented Reality*, pp. 107–116, 2013.

[262] T. Nguyen, G. Reitmayr, and D. Schmalstieg. Structural modeling from depth images. *Transactions on Visualization and Computer Graphics*, 21(11):1230–1240, 2015.

[263] J. Nilsson, A. C. E. Ödblom, J. Fredriksson, A. Zafar, and F. Ahmed. Performance evaluation method for mobile computer vision systems using augmented reality. In *2010 IEEE Virtual Reality Conference (VR)*, pp. 19–22, 2010.

[264] S. Nilsson, B. Johansson, and A. Jonsson. Using AR to support cross-organisational collaboration in dynamic tasks. In *IEEE International Symposium on Mixed and Augmented Reality*, pp. 3–12, 2009.

[265] E. Normand and M. J. McGuffin. Enlarging a smartphone with AR to create a handheld VESAD (virtually extended screen-aligned display). In *IEEE International Symposium on Mixed and Augmented Reality*, pp. 123–133, 2018.

[266] N. Norouzi, K. Kim, M. Lee, R. Schubert, A. Erickson, J. Bailenson, G. Bruder, and G. Welch. Walking your virtual dog: Analysis of awareness and proxemics with simulated support animals in augmented reality. In *2019 IEEE International Symposium on Mixed and Augmented Reality (ISMAR)*, pp. 157–168, 2019.

[267] D. Nowrouzezahrai, S. Geiger, K. Mitchell, R. Sumner, W. Jarosz, and M. Gross. Light factorization for mixed-frequency shadows in augmented reality. In *IEEE International Symposium on Mixed and Augmented Reality*, pp. 173–179, 2011.

[268] B. Nuernberger, E. Ofek, H. Benko, and A. D. Wilson. Snaptoreality: Aligning augmented reality to the real world. In *Proceedings of the 2016 CHI Conference on Human Factors in Computing Systems*, CHI '16, pp. 1233–1244. ACM, New York, NY, USA, 2016. doi: 10.1145/2858036.2858250

[269] O. Oda, C. Elvezio, M. Sukan, S. Feiner, and B. Tversky. Virtual replicas for remote assistance in virtual and augmented reality. In *Proceedings of the 28th Annual ACM Symposium on User Interface Software & Technology*, UIST '15, p. 405–415. Association for Computing Machinery, New York, NY, USA, 2015. doi: 10.1145/2807442.2807497

[270] O. Oda and S. Feiner. Interference avoidance in multi-user hand-held augmented reality. In *IEEE International Symposium on Mixed and Augmented Reality*, pp. 13–22, 2009.

[271] O. Oda and S. Feiner. 3d referencing techniques for physical objects in shared augmented reality. In *IEEE International Symposium on Mixed and Augmented Reality*, pp. 207–215, 2012.

[272] S. Oh, G. Yun, C. Park, J. Kim, and S. Choi. Vibeye: Vibration-mediated object recognition for tangible interactive applications. In *Proceedings of the 2019 CHI Conference on Human Factors in Computing Systems*, CHI '19, p. 1–12. Association for Computing Machinery, New York, NY, USA, 2019. doi: 10.1145/3290605.3300906

[273] A. Okur, S. Ahmadi, A. Bigdelou, T. Wendler, and N. Navab. MR in OR: First analysis of AR/VR visualization in 100 intra-operative freehand SPECT acquisitions. In *IEEE International Symposium on Mixed and Augmented Reality*, pp. 211–218, 2011.

[274] T. Olsson and M. Salo. Online user survey on current mobile augmented reality applications. In *IEEE International Symposium on Mixed and Augmented Reality*, pp. 75–84, 2011.

[275] T. Olsson and M. Salo. Narratives of satisfying and unsatisfying experiences of current mobile augmented reality applications. In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems*, CHI '12, pp. 2779–2788. ACM, New York, NY, USA, 2012. doi: 10.1145/2207676.2208677

[276] P. Ondrúška, P. Kohli, and S. Izadi. Mobilefusion: Real-time volumetric surface reconstruction and dense tracking on mobile phones. *Transactions on Visualization and Computer Graphics*, 21(11):1251–1258, 2015.

[277] L. Oppermann, C. Putschli, C. Brosda, O. Lobunets, and F. Prioville. The smartphone project: An augmented dance performance. In *Proceedings of the 33rd Annual ACM Conference on Human Factors in Computing Systems*, CHI '15, pp. 2569–2572. ACM, New York, NY, USA, 2015. doi: 10.1145/2702123.2702538

[278] J. Orlosky. Depth based interaction and field of view manipulation for augmented reality. In *Proceedings of the Adjunct Publication of the 27th Annual ACM Symposium on User Interface Software and Technology*, UIST'14 Adjunct, p. 5–8. Association for Computing Machinery, New York, NY, USA, 2014. doi: 10.1145/2658779.2661164

[279] J. Orlosky, P. Kim, K. Kiyokawa, T. Mashita, P. Ratsamee, Y. Uranishi, and H. Takemura. VisMerge: Light adaptive vision augmentation via spectral and temporal fusion of non-visible light. In *IEEE International Symposium on Mixed and Augmented Reality*, pp. 22–31, 2017.

[280] J. Orlosky, T. Toyama, K. Kiyokawa, and D. Sonntag. ModulAR: Eye-controlled vision augmentations for head mounted displays. *Transactions on Visualization and Computer Graphics*, 21(11):1259–1268, 2015.

[281] S. Orts-Escolano, C. Rhemann, S. Fanello, W. Chang, A. Kowdle, Y. Degtyarev, D. Kim, P. L. Davidson, S. Khamis, M. Dou, V. Tankovich, C. Loop, Q. Cai, P. A. Chou, S. Mennicken, J. Valentin, V. Pradeep, S. Wang, S. B. Kang, P. Kohli, Y. Lutchyn, C. Keskin, and S. Izadi. Holoportation: Virtual 3d teleportation in real-time. In *Proceedings of the 29th Annual Symposium on User Interface Software and Technology*, UIST '16, p. 741–754. Association for Computing Machinery, New York, NY, USA, 2016. doi: 10.1145/2984511.2984517

[282] W. Oshiro, S. Kagami, and K. Hashimoto. Perception of motion-adaptive color images displayed by a high-speed dmd projector. In *2019 IEEE Conference on Virtual Reality and 3D User Interfaces (VR)*, pp. 1790–1793, 2019.

[283] T. Oskiper, H. Chiu, Z. Zhu, S. Samaresekera, and R. Kumar. Stable vision-aided navigation for large-area augmented reality. In *2011 IEEE Virtual Reality Conference*, pp. 63–70, 2011.

[284] T. Oskiper, S. Samarasekera, and R. Kumar. Multi-sensor navigation algorithm using monocular camera, IMU and GPS for large scale augmented reality. In *IEEE International Symposium on Mixed and Augmented Reality*, pp. 71–80, 2012.

[285] T. Oskiper, M. Sizintsev, V. Branzoi, S. Samarasekera, and R. Kumar. Augmented reality binoculars. In *IEEE International Symposium on Mixed and Augmented Reality*, pp. 219–228, 2013.

[286] T. Oskiper, M. Sizintsev, V. Branzoi, S. Samarasekera, and R. Kumar. Augmented reality scout: Joint unaided-eye and telescopic-zoom system for immersive team training. In *IEEE International Symposium on Mixed and Augmented Reality*, pp. 25–30, 2015.

[287] M. Otsuki, K. Sugihara, A. Kimura, F. Shibata, and H. Tamura. Mai painting brush: An interactive device that realizes the feeling of real painting. In *Proceedings of the 23nd Annual ACM Symposium on User Interface Software and Technology*, UIST '10, p. 97–100. Association for Computing Machinery, New York, NY, USA, 2010. doi: 10.1145/1866029.1866045

[288] O. Oyekoya, W. Steptoe, and A. Steed. Sphereavatar: A situated display to represent a remote collaborator. In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems*, CHI '12, pp. 2551–2560. ACM, New York, NY, USA, 2012. doi: 10.1145/2207676.2208642

[289] J. Paavilainen, H. Korhonen, K. Alha, J. Stenros, E. Koskinen, and F. Mayra. The pokémon go experience: A location-based augmented reality mobile game goes mainstream. In *Proceedings of the 2017 CHI Conference on Human Factors in Computing Systems*, CHI '17, pp. 2493–2498. ACM, New York, NY, USA, 2017. doi: 10.1145/3025453.3025871

[290] F. Palmas, J. Cichor, D. A. Plecher, and G. Klinker. Acceptance and effectiveness of a virtual reality public speaking training. In *2019 IEEE International Symposium on Mixed and Augmented Reality (ISMAR)*, pp. 363–371, 2019.

[291] Q. Pan, C. Arth, G. Reitmayr, E. Rosten, and T. Drummond. Rapid scene reconstruction on mobile phones from panoramic images. In *IEEE International Symposium on Mixed and Augmented Reality*, pp. 55–64, 2011.

[292] G. Park and W. Woo. Hybrid 3D hand articulations tracking guided by classification and search space adaptation. In *IEEE International Symposium on Mixed and Augmented Reality*, pp. 57–69, 2018.

[293] Y. Park, V. Lepetit, and W. Woo. ESM-Blur: Handling amp; rendering blur in 3D tracking and augmentation. In *IEEE International Symposium on Mixed and Augmented Reality*, pp. 163–166, 2009.

[294] Y. Park, V. Lepetit, and W. Woo. Texture-less object tracking with online training using an RGB-D camera. In *IEEE International Symposium on Mixed and Augmented Reality*, pp. 121–126, 2011.

[295] C. J. Paulus, N. Haouchine, D. Cazier, and S. Cotin. Augmented reality during cutting and tearing of deformable objects. In *IEEE International Symposium on Mixed and Augmented Reality*, pp. 54–59, 2015.

[296] F. Pece, W. Steptoe, F. Wanner, S. Julier, T. Weyrich, J. Kautz, and A. Steed. Panoinserts: Mobile spatial teleconferencing. In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems*, CHI '13, pp. 1319–1328. ACM, New York, NY, USA, 2013. doi: 10.1145/2470654.2466173

[297] E. Peillard, F. Argelaguet, J. Normand, A. Lécuyer, and G. Moreau. Studying exocentric distance perception in optical see-through augmented reality. In *2019 IEEE International Symposium on Mixed and Augmented Reality (ISMAR)*, pp. 115–122, 2019.

[298] H. Peng, J. Briggs, C.-Y. Wang, K. Guo, J. Kider, S. Mueller, P. Baudisch, and F. Guimbretière. Roma: Interactive fabrication with augmented reality and a robotic 3d printer. In *Proceedings of the 2018 CHI Conference on Human Factors in Computing Systems*, CHI '18, pp. 579:1–579:12. ACM, New York, NY, USA, 2018. doi: 10.1145/3173574.3174153

[299] S. Pessoa, G. Moura, J. Lima, V. Teichrieb, and J. Kelner. Photorealistic rendering for augmented reality: A global illumination and brdf solution. In *2010 IEEE Virtual Reality Conference (VR)*, pp. 3–10, 2010.

[300] N. Petersen, A. Pagani, and D. Stricker. Real-time modeling and tracking manual workflows from first-person vision. In *IEEE International Symposium on Mixed and Augmented Reality*, pp. 117–124, 2013.

[301] N. Petersen and D. Stricker. Continuous natural user interface: Reducing the gap between real and digital world. In *IEEE International Symposium on Mixed and Augmented Reality*, pp. 23–26, 2009.

[302] N. Petersen and D. Stricker. Learning task structure from video examples for workflow tracking and authoring. In *IEEE International Symposium on Mixed and Augmented Reality*, pp. 237–246, 2012.

[303] L. Petikam, A. Chalmers, and T. Rhee. Visual perception of real world depth map resolution for mixed reality rendering. In *2018 IEEE Conference on Virtual Reality and 3D User Interfaces (VR)*, pp. 401–408, 2018.

[304] J. Pilet and H. Saito. Virtually augmenting hundreds of real pictures: An approach based on learning, retrieval, and tracking. In *2010 IEEE Virtual Reality Conference (VR)*, pp. 71–78, 2010.

[305] C. Pirchheim and G. Reitmayr. Homography-based planar mapping and tracking for mobile phones. In *IEEE International Symposium on Mixed and Augmented Reality*, pp. 27–36, 2011.

[306] C. Pirchheim, D. Schmalstieg, and G. Reitmayr. Handling pure camera rotation in keyframe-based SLAM. In *IEEE International Symposium on Mixed and Augmented Reality*, pp. 229–238, 2013.

[307] T. Piumsomboon, D. Altimira, H. Kim, A. Clark, G. Lee, and M. Billinghurst. Grasp-shell vs gesture-speech: A comparison of direct and indirect natural interaction techniques in augmented reality. In *IEEE International Symposium on Mixed and Augmented Reality*, pp. 73–82, 2014.

[308] T. Piumsomboon, G. A. Lee, B. Ens, B. H. Thomas, and M. Billinghurst. Superman vs giant: A study on spatial perception for a multi-scale mixed reality flying telepresence interface. *Transactions on Visualization and Computer Graphics*, 24(11):2974–2982, 2018.

[309] T. Piumsomboon, G. A. Lee, J. D. Hart, B. Ens, R. W. Lindeman, B. H. Thomas, and M. Billinghurst. Mini-me: An adaptive avatar for mixed reality remote collaboration. In *Proceedings of the 2018 CHI Conference on Human Factors in Computing Systems*, CHI '18, pp. 46:1–46:13. ACM, New York, NY, USA, 2018. doi: 10.1145/3173574.3173620

[310] T. Piumsomboon, G. A. Lee, A. Irlitti, B. Ens, B. H. Thomas, and M. Billinghurst. On the shoulder of the giant: A multi-scale mixed reality collaboration with 360 video sharing and tangible interaction. In *Proceedings of the 2019 CHI Conference on Human Factors in Computing Systems*, CHI '19, p. 1–17. Association for Computing Machinery, New York, NY, USA, 2019. doi: 10.1145/3290605.3300458

[311] P. Pjanic, S. Willi, and A. Grundhöfer. Geometric and photometric consistency in a mixed video and galvanoscopic scanning laser projection mapping system. *Transactions on Visualization and Computer Graphics*, 23(11):2430–2439, 2017.

[312] P. Pjanic, S. Willi, D. Iwai, and A. Grundhöfer. Seamless multi-projection revisited. *Transactions on Visualization and Computer Graphics*, 24(11):2963–2973, 2018.

[313] A. Plopski, J. Orlosky, Y. Itoh, C. Nitschke, K. Kiyokawa, and G. Klinker. Automated spatial calibration of hmd systems with unconstrained eye-cameras. In *IEEE International Symposium on Mixed and Augmented Reality*, pp. 94–99, 2016.

[314] V. Pradeep, C. Rhemann, S. Izadi, C. Zach, M. Bleyer, and S. Bathiche. Monofusion: Real-time 3D reconstruction of small scenes with a single web camera. In *IEEE International Symposium on Mixed and Augmented Reality*, pp. 83–88, 2013.

[315] V. A. Prisacariu, O. Kähler, D. W. Murray, and I. D. Reid. Simultaneous 3D tracking and reconstruction on a mobile phone. In *IEEE International Symposium on Mixed and Augmented Reality*, pp. 89–98, 2013.

[316] E. Prytz, S. Nilsson, and A. Jönsson. The importance of eye-contact for collaboration in AR systems. In *IEEE International Symposium on Mixed and Augmented Reality*, pp. 119–126, 2010.

[317] P. Punpongsanon, D. Iwai, and K. Sato. SoftAR: Visually manipulating haptic softness perception in spatial augmented reality. *Transactions on Visualization and Computer Graphics*, 21(11):1279–1288, 2015.

[318] D. Pustka, J. Hülß, J. Willneff, F. Pankratz, M. Huber, and G. Klinker. Optical outside-in tracking using unmodified mobile phones. In *IEEE International Symposium on Mixed and Augmented Reality*, pp. 81–89, 2012.

[319] D. Pustka, J. Willneff, O. Wenisch, P. Lükewille, K. Achatz, P. Keitler, and G. Klinker. Determining the point of minimum error for 6DOF pose uncertainty representation. In *IEEE International Symposium on Mixed and Augmented Reality*, pp. 37–45, 2010.

[320] J. Qian, J. Ma, X. Li, B. Attal, H. Lai, J. Tompkin, J. F. Hughes, and J. Huang. Portal-ble: Intuitive free-hand manipulation in unbounded smartphone-based augmented reality. In *Proceedings of the 32nd Annual ACM Symposium on User Interface Software and Technology*, UIST '19, p. 133–145. Association for Computing Machinery, New York, NY, USA, 2019. doi: 10.1145/3332165.3347904

[321] L. Qian, A. Plopski, N. Navab, and P. Kazanides. Restoring the awareness in the occluded visual field for optical see-through head-mounted displays. *Transactions on Visualization and Computer Graphics*, 24(11):2936–2946, 2018.

[322] I. Radu and B. Schneider. What can we learn from augmented reality (AR)? In *Proceedings of the 2019 CHI Conference on Human Factors in Computing Systems*, CHI '19, p. 1–12. Association for Computing Machinery, New York, NY, USA, 2019. doi: 10.1145/3290605.3300774

[323] J. R. Rambach, A. Tewari, A. Pagani, and D. Stricker. Learning to fuse: A deep learning approach to visual-inertial camera pose estimation. In *IEEE International Symposium on Mixed and Augmented Reality*, pp. 71–76, 2016.

[324] F. Rameau, H. Ha, K. Joo, J. Choi, K. Park, and I. S. Kweon. A real-time augmented reality system to see-through cars. *Transactions on Visualization and Computer Graphics*, 22(11):2395–2404, 2016.

[325] Q. Rao, T. Tropper, C. Grünler, M. Hammori, and S. Chakraborty. AR-IVI — implementation of in-vehicle augmented reality. In *IEEE International Symposium on Mixed and Augmented Reality*, pp. 3–8, 2014.

[326] K. Rathinavel, H. Wang, A. Blate, and H. Fuchs. An extended depth-at-field volumetric near-eye augmented reality display. *Transactions on Visualization and Computer Graphics*, 24(11):2857–2866, 2018.

[327] H. Regenbrecht, G. McGregor, C. Ott, S. Hoermann, T. Schubert, L. Hale, J. Hoermann, B. Dixon, and E. Franz. Out of reach?—a novel AR interface approach for motor rehabilitation. In *IEEE International Symposium on Mixed and Augmented Reality*, pp. 219–228, 2011.

[328] H. Regenbrecht, K. Meng, A. Reepen, S. Beck, and T. Langlotz. Mixed voxel reality: Presence and embodiment in low fidelity, visually coherent, mixed reality environments. In *IEEE International Symposium on Mixed and Augmented Reality*, pp. 90–99, 2017.

[329] C. Reichherzer, A. Cunningham, J. Walsh, M. Kohler, M. Billinghurst, and B. H. Thomas. Narrative and spatial memory for jury viewings in a reconstructed virtual environment. *Transactions on Visualization and Computer Graphics*, 24(11):2917–2926, 2018.

[330] D. Reilly, A. Echenique, A. Wu, A. Tang, and W. K. Edwards. Mapping out work in a mixed reality project room. In *Proceedings of the 33rd Annual ACM Conference on Human Factors in Computing Systems*, CHI '15, pp. 887–896. ACM, New York, NY, USA, 2015. doi: 10.1145/2702123.2702506

[331] C. Resch, P. Keitler, and G. Klinker. Sticky projections — a new approach to interactive shader lamp tracking. In *IEEE International Symposium on Mixed and Augmented Reality*, pp. 151–156, 2014.

[332] C. Resch, H. Naik, P. Keitler, S. Benkhardt, and G. Klinker. On-site semi-automatic calibration and registration of a projector-camera system using arbitrary objects with known geometry. *Transactions on Visualization and Computer Graphics*, 21(11):1211–1220, 2015.

[333] T. Richter-Trummer, D. Kalkofen, J. Park, and D. Schmalstieg. Instant mixed reality lighting from casual scanning. In *IEEE International Symposium on Mixed and Augmented Reality*, pp. 27–36, 2016.

[334] M. Rietzler, J. Gugenheimer, T. Hirzle, M. Deubzer, E. Langbehn, and E. Rukzio. Rethinking redirected walking: On the use of curvature gains beyond perceptual limitations and revisiting bending gains. In *IEEE International Symposium on Mixed and Augmented Reality*, pp. 115–122, 2018.

[335] K. Rohmer, W. Büschel, R. Dachselt, and T. Grosch. Interactive near-field illumination for photorealistic augmented reality on mobile devices. In *IEEE International Symposium on Mixed and Augmented Reality*, pp. 29–38, 2014.

[336] K. Rohmer and T. Grosch. Tiled frustum culling for differential rendering on mobile devices. In *IEEE International Symposium on Mixed and Augmented Reality*, pp. 37–42, 2015.

[337] K. Rohmer, J. Jendersie, and T. Grosch. Natural environment illumination: Coherent interactive augmented reality for mobile and non-mobile devices. *Transactions on Visualization and Computer Graphics*, 23(11):2474–2484, 2017.

[338] P. Rojtberg and A. Kuijper. Efficient pose selection for interactive camera calibration. In *IEEE International Symposium on Mixed and Augmented Reality*, pp. 31–36, 2018.

[339] J. S. Roo, J. Basset, P.-A. Cinquin, and M. Hachet. Understanding users' capability to transfer information between mixed and virtual reality: Position estimation across modalities and perspectives. In *Proceedings of the 2018 CHI Conference on Human Factors in Computing Systems*, CHI '18, pp. 363:1–363:12. ACM, New York, NY, USA, 2018. doi: 10.1145/3173574.3173937

[340] J. S. Roo, R. Gervais, J. Frey, and M. Hachet. Inner garden: Connecting inner states to a mixed reality sandbox for mindfulness. In *Proceedings of the 2017 CHI Conference on Human Factors in Computing Systems*, CHI '17, pp. 1459–1470. ACM, New York, NY, USA, 2017. doi: 10.1145/3025453.3025743

[341] H. Roodaki, K. Filippatos, A. Eslami, and N. Navab. Introducing augmented reality to optical coherence tomography in ophthalmic microsurgery. In *IEEE International Symposium on Mixed and Augmented Reality*, pp. 1–6, 2015.

[342] H. Roodaki, N. Navab, A. Eslami, C. Stapleton, and N. Navab. Sonifeye: Sonification of visual information using physical modeling sound synthesis. *Transactions on Visualization and Computer Graphics*, 23(11):2366–2371, 2017.

[343] C. S. Rosales, G. Pointon, H. Adams, J. Stefanucci, S. Creem-Regehr, W. B. Thompson, and B. Bodenheimer. Distance judgments to on- and off-ground objects in augmented reality. In *2019 IEEE Conference on Virtual Reality and 3D User Interfaces (VR)*, pp. 237–243, 2019.

[344] A. Roussos, C. Russell, R. Garg, and L. Agapito. Dense multibody motion estimation and reconstruction from a handheld camera. In *IEEE International Symposium on Mixed and Augmented Reality*, pp. 31–40, 2012.

[345] M. Runz, M. Buffier, and L. Agapito. Maskfusion: Real-time recognition, tracking and reconstruction of multiple moving objects. In *IEEE International Symposium on Mixed and Augmented Reality*, pp. 10–20, 2018.

[346] D. Saakes, H.-S. Yeo, S.-T. Noh, G. Han, and W. Woo. Mirror mirror: An on-body t-shirt design system. In *Proceedings of the 2016 CHI Conference on Human Factors in Computing Systems*, CHI '16, pp. 6058–6063. ACM, New York, NY, USA, 2016. doi: 10.1145/2858036.2858282

[347] S. Sadri, S. A. Kohen, C. Elvezio, S. H. Sun, A. Grinshpoon, G. J. Loeb, N. Basu, and S. K. Feiner. Manipulating 3d anatomic models in augmented reality: Comparing a hands-free approach and a manual approach. In *2019 IEEE International Symposium on Mixed and Augmented Reality (ISMAR)*, pp. 93–102, 2019.

[348] R. F. Salas-Moreno, B. Glocken, P. H. J. Kelly, and A. J. Davison. Dense planar SLAM. In *IEEE International Symposium on Mixed and Augmented Reality*, pp. 157–164, 2014.

[349] C. Sandor, A. Cunningham, A. Dey, and V. Mattila. An augmented reality x-ray system based on visual saliency. In *IEEE International Symposium on Mixed and Augmented Reality*, pp. 27–36, 2010.

[350] A. Sankar and S. Seitz. Capturing indoor scenes with smartphones. In *Proceedings of the 25th Annual ACM Symposium on User Interface Software and Technology*, UIST '12, p. 403–412. Association for Computing Machinery, New York, NY, USA, 2012. doi: 10.1145/2380116.2380168

[351] A. Sankar and S. M. Seitz. Interactive room capture on 3d-aware mobile devices. In *Proceedings of the 30th Annual ACM Symposium on User Interface Software and Technology*, UIST '17, p. 415–426. Association for Computing Machinery, New York, NY, USA, 2017. doi: 10.1145/3126594.3126629

[352] N. K. Sankaran, H. J. Nisar, J. Zhang, K. Formella, J. Amos, L. T. Barker, J. A. Vozenilek, S. M. LaValle, and T. Kesavadas. Efficacy study on interactive mixed reality (imr) software with sepsis prevention medical education. In *2019 IEEE Conference on Virtual Reality and 3D User Interfaces (VR)*, pp. 664–670, 2019.

[353] N. Saquib, R. H. Kazi, L.-Y. Wei, and W. Li. Interactive body-driven graphics for augmented video performance. In *Proceedings of the 2019 CHI Conference on Human Factors in Computing Systems*, CHI '19, p. 1–12. Association for Computing Machinery, New York, NY, USA, 2019. doi: 10.1145/3290605.3300852

[354] K. A. Satriadi, B. Ens, M. Cordeil, B. Jenny, T. Czauderna, and W. Willett. Augmented reality map navigation with freehand gestures. In *2019 IEEE Conference on Virtual Reality and 3D User Interfaces (VR)*, pp. 593–603, 2019.

[355] G. Schall, D. Wagner, G. Reitmayr, E. Taichmann, M. Wieser, D. Schmalstieg, and B. Hofmann-Wellenhof. Global pose estimation using multi-sensor fusion for outdoor augmented reality. In *IEEE International Symposium on Mixed and Augmented Reality*, pp. 153–162, 2009.

[356] S. B. Schorr and A. M. Okamura. Fingertip tactile devices for virtual object manipulation and exploration. In *Proceedings of the 2017 CHI Conference on Human Factors in Computing Systems*, CHI '17, pp. 3115–3119. ACM, New York, NY, USA, 2017. doi: 10.1145/3025453.3025744

[357] T. Schwandt and W. Broll. A single camera image based approach for glossy reflections in mixed reality applications. In *IEEE International Symposium on Mixed and Augmented Reality*, pp. 37–43, 2016.

[358] B. Schwerdtfeger, R. Reif, W. A. Gunthner, G. Klinker, D. Hamacher, L. Schega, I. Bockelmann, F. Doil, and J. Tumler. Pick-by-vision: A first stress test. In *IEEE International Symposium on Mixed and Augmented Reality*, pp. 115–124, 2009.

[359] T. Schöps, J. Engel, and D. Cremers. Semi-dense visual odometry for AR on a smartphone. In *IEEE International Symposium on Mixed and Augmented Reality*, pp. 145–150, 2014.

[360] T. Schöps, M. R. Oswald, P. Speciale, S. Yang, and M. Pollefeys. Real-time view correction for mobile devices. *Transactions on Visualization and Computer Graphics*, 23(11):2455–2462, 2017.

[361] L. Shapira, J. Amores, and X. Benavides. TactileVR: Integrating physical toys into learn and play virtual reality experiences. In *IEEE International Symposium on Mixed and Augmented Reality*, pp. 100–106, 2016.

[362] L. Shapira and D. Freedman. Reality skins: Creating immersive and tactile virtual environments. In *IEEE International Symposium on Mixed and Augmented Reality*, pp. 115–124, 2016.

[363] X. Shi, J. Pan, Z. Hu, J. Lin, S. Guo, M. Liao, Y. Pan, and L. Liu. Accurate and fast classification of foot gestures for virtual locomotion. In *2019 IEEE International Symposium on Mixed and Augmented Reality (ISMAR)*, pp. 178–189, 2019.

[364] J. Shin, H. Kim, C. Parker, H. Kim, S. Oh, and W. Woo. Is any room really ok? the effect of room size and furniture on presence, narrative engagement, and usability during a space-adaptive augmented reality game. In *2019 IEEE International Symposium on Mixed and Augmented Reality (ISMAR)*, pp. 135–144, 2019.

[365] C. Siegl, V. Lange, M. Stamminger, F. Bauer, and J. Thies. Faceforge: Markerless non-rigid face multi-projection mapping. *Transactions on Visualization and Computer Graphics*, 23(11):2440–2446, 2017.

[366] G. Simon. Tracking-by-synthesis using point features and pyramidal blurring. In *IEEE International Symposium on Mixed and Augmented Reality*, pp. 85–92, 2011.

[367] D. Sjölie, K. Bodin, E. Elgh, J. Eriksson, L.-E. Janlert, and L. Nyberg. Effects of interactivity and 3d-motion on mental rotation brain activity in an immersive virtual environment. In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems*, CHI '10, pp. 869–878. ACM, New York, NY, USA, 2010. doi: 10.1145/1753326.1753454

[368] M. Smith, N. Doutcheva, J. L. Gabbard, and G. Burnett. Optical see-through head up displays' effect on depth judgments of real world objects. In *2015 IEEE Virtual Reality (VR)*, pp. 401–405, 2015.

[369] R. S. Sodhi, B. R. Jones, D. Forsyth, B. P. Bailey, and G. Maciocci. Bethere: 3d mobile collaboration with spatial input. In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems*, CHI '13, pp. 179–188. ACM, New York, NY, USA, 2013. doi: 10.1145/2470654.2470679

[370] A. Souchet, S. Philippe, F. Ober, A. Lévêque, and L. Leroy. Investigating cyclical stereoscopy effects over visual discomfort and fatigue in virtual reality while learning. In *2019 IEEE International Symposium on Mixed and Augmented Reality (ISMAR)*, pp. 328–338, 2019.

[371] M. Spindler, M. Martsch, and R. Dachselt. Going beyond the surface: Studying multi-layer interaction above the tabletop. In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems*, CHI '12, pp. 1277–1286. ACM, New York, NY, USA, 2012. doi: 10.1145/2207676.2208583

[372] S. Y. Ssin, J. A. Walsh, R. T. Smith, A. Cunningham, and B. H. Thomas. Geogate: Correlating geo-temporal datasets using an augmented reality space-time cube and tangible interactions. In *2019 IEEE Conference on Virtual Reality and 3D User Interfaces (VR)*, pp. 210–219, 2019.

[373] A. Steed and S. Julier. Behaviour-aware sensor fusion: Continuously inferring the alignment of coordinate systems from user behaviour. In *IEEE International Symposium on Mixed and Augmented Reality*, pp. 163–172, 2013.

[374] W. Steptoe, S. Julier, and A. Steed. Presence and discernability in conventional and non-photorealistic immersive augmented reality. In *IEEE International Symposium on Mixed and Augmented Reality*, pp. 213–218, 2014.

[375] W. Steptoe, A. Steed, A. Rovira, and J. Rae. Lie tracking: Social presence, truth and deception in avatar-mediated telecommunication. In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems*, CHI '10, pp. 1039–1048. ACM, New York, NY, USA, 2010. doi: 10.1145/1753326.1753481

[376] P. Stotko, S. Krumpen, M. Weinmann, and R. Klein. Efficient 3d reconstruction and streaming for group-scale multi-client live telepresence. In *2019 IEEE International Symposium on Mixed and Augmented Reality (ISMAR)*, pp. 19–25, 2019.

[377] M. Sukan, C. Elvezio, O. Oda, S. Feiner, and B. Tversky. Parafrustum: Visualization techniques for guiding a user to a constrained set of viewing positions and orientations. In *Proceedings of the 27th Annual ACM Symposium on User Interface Software and Technology*, UIST '14, p. 331–340. Association for Computing Machinery, New York, NY, USA, 2014. doi: 10.1145/2642918.2647417

[378] M. Sukan, S. Feiner, B. Tversky, and S. Energin. Quick viewpoint switching for manipulating virtual objects in hand-held augmented reality using stored snapshots. In *IEEE International Symposium on Mixed and Augmented Reality*, pp. 217–226, 2012.

[379] Y. Sun, A. Armengol-Urpi, S. N. Reddy Kantareddy, J. Siegel, and S. Sarma. Magichand: Interact with iot devices in augmented reality environment. In *2019 IEEE Conference on Virtual Reality and 3D User Interfaces (VR)*, pp. 1738–1743, 2019.

[380] J. E. Swan, G. Singh, and S. R. Ellis. Matching and reaching depth judgments with real and augmented reality targets. *Transactions on Visualization and Computer Graphics*, 21(11):1289–1298, 2015.

[381] C. Sweeney, J. Flynn, B. Nuernberger, M. Turk, and T. Höllerer. Efficient computation of absolute pose for gravity-aware augmented reality. In *IEEE International Symposium on Mixed and Augmented Reality*, pp. 19–24, 2015.

[382] J. R. Sánchez, H. Álvarez, and D. Borro. Towards real time 3D tracking and reconstruction on a GPU using monte carlo simulations. In *IEEE International Symposium on Mixed and Augmented Reality*, pp. 185–192, 2010.

[383] D. J. Tan, N. Navab, and F. Tombari. Looking beyond the simple scenarios: Combining learners and optimizers in 3D temporal tracking. *Transactions on Visualization and Computer Graphics*, 23(11):2399–2409, 2017.

[384] W. Tan, H. Liu, Z. Dong, G. Zhang, and H. Bao. Robust monocular SLAM in dynamic environments. In *IEEE International Symposium on Mixed and Augmented Reality*, pp. 209–218, 2013.

[385] C. Taylor, C. Mullany, R. McNicholas, and D. Cosker. Vr props: An end-to-end pipeline for transporting real objects into virtual and augmented environments. In *2019 IEEE International Symposium on Mixed and Augmented Reality (ISMAR)*, pp. 83–92, 2019.

[386] T. Teo, L. Lawrence, G. A. Lee, M. Billinghurst, and M. Adcock. Mixed reality remote collaboration combining 360 video and 3d reconstruction. In *Proceedings of the 2019 CHI Conference on Human Factors in Computing Systems*, CHI '19, p. 1–14. Association for Computing Machinery, New York, NY, USA, 2019. doi: 10.1145/3290605.3300431

[387] S. Thanyadit, P. Punpongsanon, and T. Pong. Observar: Visualization system for observing virtual reality users using augmented reality. In *2019 IEEE International Symposium on Mixed and Augmented Reality (ISMAR)*, pp. 258–268, 2019.

[388] S. Thompson, A. Chalmers, and T. Rhee. Real-time mixed reality rendering for underwater 360° videos. In *2019 IEEE International Symposium on Mixed and Augmented Reality (ISMAR)*, pp. 74–82, 2019.

[389] B. Thoravi Kumaravel, F. Anderson, G. Fitzmaurice, B. Hartmann, and T. Grossman. Loki: Facilitating remote instruction of physical tasks using bi-directional mixed-reality telepresence. In *Proceedings of the 32nd Annual ACM Symposium on User Interface Software and Technology*, UIST '19, p. 161–174. Association for Computing Machinery, New York, NY, USA, 2019. doi: 10.1145/3332165.3347872

[390] M. Tomioka, S. Ikeda, and K. Sato. Approximated user-perspective rendering in tablet-based augmented reality. In *IEEE International Symposium on Mixed and Augmented Reality*, pp. 21–28, 2013.

[391] A. Torres-Gómez and W. Mayol-Cuevas. Recognition and reconstruction of transparent objects for augmented reality. In *IEEE International Symposium on Mixed and Augmented Reality*, pp. 129–134, 2014.

[392] J. Tsukamoto, D. Iwai, and K. Kashima. Radiometric compensation for cooperative distributed multi-projection system through 2-DOF distributed control. *Transactions on Visualization and Computer Graphics*, 21(11):1221–1229, 2015.

[393] H. Uchiyama and E. Marchand. Toward augmenting everything: Detecting and tracking geometrical features on planar objects. In *IEEE International Symposium on Mixed and Augmented Reality*, pp. 17–25, 2011.

[394] H. Uchiyama and H. Saito. Augmenting text document by on-line learning of local arrangement of keypoints. In *IEEE International Symposium on Mixed and Augmented Reality*, pp. 95–98, 2009.

[395] D. Valtchanov and M. Hancock. Enviropulse: Providing feedback about the expected affective valence of the environment. In *Proceedings of the 33rd Annual ACM Conference on Human Factors in Computing Systems*, CHI '15, pp. 2073–2082. ACM, New York, NY, USA, 2015. doi: 10.1145/2702123.2702510

[396] A. van den Hengel, R. Hill, B. Ward, and A. Dick. In situ image-based modeling. In *IEEE International Symposium on Mixed and Augmented Reality*, pp. 107–110, 2009.

[397] A. Vargas González, S. Koh, K. Kapalo, R. Sottilare, P. Garrity, M. Billinghurst, and J. LaViola. A comparison of desktop and augmented reality scenario based training authoring tools. In *2019 IEEE International Symposium on Mixed and Augmented Reality (ISMAR)*, pp. 339–350, 2019.

[398] K. Čopič Pucihar, P. Coulton, and J. Alexander. The use of surrounding visual context in handheld ar: Device vs. user perspective rendering. In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems*, CHI '14, pp. 197–206. ACM, New York, NY, USA, 2014. doi: 10.1145/2556288.2557125

[399] E. E. Veas, E. Mendez, S. K. Feiner, and D. Schmalstieg. Directing attention and influencing memory with visual saliency modulation. In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems*, CHI '11, pp. 1471–1480. ACM, New York, NY, USA, 2011. doi: 10.1145/1978942.1979158

[400] J. Ventura and T. Hollerer. Online environment model estimation for augmented reality. In *IEEE International Symposium on Mixed and Augmented Reality*, pp. 103–106, 2009.

[401] J. Ventura and T. Höllerer. Wide-area scene mapping for mobile visual tracking. In *IEEE International Symposium on Mixed and Augmented Reality*, pp. 3–12, 2012.

[402] V. Vinayagamoorthy, M. Glancy, C. Ziegler, and R. Schäffer. Personalising the tv experience using augmented reality: An exploratory study on delivering synchronised sign language interpretation. In *Proceedings of the 2019 CHI Conference on Human Factors in Computing Systems*, CHI '19, p. 1–12. Association for Computing Machinery, New York, NY, USA, 2019. doi: 10.1145/3290605.3300762

[403] A. Voit, S. Mayer, V. Schwind, and N. Henze. Online, vr, ar, lab, and in-situ: Comparison of research methods to evaluate smart artifacts. In *Proceedings of the 2019 CHI Conference on Human Factors in Computing Systems*, CHI '19, p. 1–12. Association for Computing Machinery, New York, NY, USA, 2019. doi: 10.1145/3290605.3300737

[404] B. Volmer, J. Baumeister, S. Von Itzstein, I. Bornkessel-Schlesewsky, M. Schlesewsky, M. Billinghurst, and B. H. Thomas. A comparison of predictive spatial augmented reality cues for procedural tasks. *Transactions on Visualization and Computer Graphics*, 24(11):2846–2856, 2018.

[405] A. Vovk, F. Wild, W. Guest, and T. Kuula. Simulator sickness in augmented reality training using the microsoft hololens. In *Proceedings of the 2018 CHI Conference on Human Factors in Computing Systems*, CHI '18, pp. 209:1–209:9. ACM, New York, NY, USA, 2018. doi: 10.1145/3173574.3173783

[406] P. Wacker, O. Nowak, S. Voelker, and J. Borchers. Arpen: Mid-air object manipulation techniques for a bimanual ar system with pen & smartphone. In *Proceedings of the 2019 CHI Conference on Human Factors in Computing Systems*, CHI '19, p. 1–12. Association for Computing Machinery, New York, NY, USA, 2019. doi: 10.1145/3290605.3300849

[407] D. Wagner, D. Schmalstieg, and H. Bischof. Multiple target detection and tracking with guaranteed framerates on mobile phones. In *IEEE International Symposium on Mixed and Augmented Reality*, pp. 57–64, 2009.

[408] J. Walker, B. Li, K. Vertanen, and S. Kuhl. Efficient typing on a visually occluded physical keyboard. In *Proceedings of the 2017 CHI Conference on Human Factors in Computing Systems*, CHI '17, pp. 5457–5461. ACM, New York, NY, USA, 2017. doi: 10.1145/3025453.3025783

[409] M. E. Walker, D. Szafir, and I. Rae. The influence of size in augmented reality telepresence avatars. In *2019 IEEE Conference on Virtual Reality and 3D User Interfaces (VR)*, pp. 538–546, 2019.

[410] D. R. Walton, D. Thomas, A. Steed, and A. Sugimoto. Synthesis of environment maps for mixed reality. In *IEEE International Symposium on Mixed and Augmented Reality*, pp. 72–81, 2017.

[411] B. Wang, G. Wang, A. Sharf, Y. Li, F. Zhong, X. Qin, D. Cohenor, and B. Chen. Active assembly guidance with online video parsing. In *2018 IEEE Conference on Virtual Reality and 3D User Interfaces (VR)*, pp. 459–466, 2018.

[412] I. Wang, J. Smith, and J. Ruiz. Exploring virtual agents for augmented reality. In *Proceedings of the 2019 CHI Conference on Human Factors in Computing Systems*, CHI '19, p. 1–12. Association for Computing Machinery, New York, NY, USA, 2019. doi: 10.1145/3290605.3300511

[413] J. Wang, P. Fallavollita, L. Wang, M. Kreiser, and N. Navab. Augmented reality during angiography: Integration of a virtual mirror for improved 2D/3D visualization. In *IEEE International Symposium on Mixed and Augmented Reality*, pp. 257–264, 2012.

[414] X. Wang, C. Schulte zu Berge, S. Demirci, P. Fallavollita, and N. Navab. Improved interventional x-ray appearance. In *IEEE International Symposium on Mixed and Augmented Reality*, pp. 237–242, 2014.

[415] O. Wasenmüller, M. Meyer, and D. Stricker. Augmented reality 3D discrepancy check in industrial applications. In *IEEE International Symposium on Mixed and Augmented Reality*, pp. 125–134, 2016.

[416] Y. Watanabe, T. Kato, and M. ishikawa. Extended dot cluster marker for high-speed 3D tracking in dynamic projection mapping. In *IEEE International Symposium on Mixed and Augmented Reality*, pp. 52–61, 2017.

[417] C. Weichel, M. Lau, D. Kim, N. Villar, and H. W. Gellersen. Mixfab: A mixed-reality environment for personal fabrication. In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems*, CHI '14, pp. 3855–3864. ACM, New York, NY, USA, 2014. doi: 10.1145/2556288.2557090

[418] P. Weir, C. Sandor, M. Swoboda, T. Nguyen, U. Eck, G. Reitmayr, and A. Day. Burnar: Involuntary heat sensations in augmented reality. In *2013 IEEE Virtual Reality (VR)*, pp. 43–46, 2013.

[419] S. Werrlich, A. Daniel, A. Ginger, P. Nguyen, and G. Notni. Comparing HMD-based and paper-based training. In *IEEE International Symposium on Mixed and Augmented Reality*, pp. 134–142, 2018.

[420] S. White and S. Feiner. Sitelens: Situated visualization techniques for urban site visits. In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems*, CHI '09, pp. 1117–1120. ACM, New York, NY, USA, 2009. doi: 10.1145/1518701.1518871

[421] S. White, D. Feng, and S. Feiner. Interaction and presentation techniques for shake menus in tangible augmented reality. In *IEEE International Symposium on Mixed and Augmented Reality*, pp. 39–48, 2009.

[422] M. Whitlock, E. Harnner, J. R. Brubaker, S. Kane, and D. A. Szafir. Interacting with distant objects in augmented reality. In *2018 IEEE Conference on Virtual Reality and 3D User Interfaces (VR)*, pp. 41–48, 2018.

[423] C. Wienrich, R. Gross, F. Kretschmer, and G. Müller-Plath. Developing and proving a framework for reaction time experiments in vr to objectively measure social interaction with virtual agents. In *2018 IEEE Conference on Virtual Reality and 3D User Interfaces (VR)*, pp. 191–198, 2018.

[424] F. Wientapper, H. Wuest, P. Rojtberg, and D. Fellner. A camera-based calibration for automotive augmented reality head-up-displays. In *IEEE International Symposium on Mixed and Augmented Reality*, pp. 189–197, 2013.

[425] C. A. Wiesner, M. Ruf, D. Sirim, and G. Klinker. 3D-FRC: Depiction of the future road course in the head-up-display. In *IEEE International Symposium on Mixed and Augmented Reality*, pp. 136–143, 2017.

[426] S. Willi and A. Grundhöfer. Spatio-temporal point path analysis and optimization of a galvanoscopic scanning laser projector. *Transactions on Visualization and Computer Graphics*, 22(11):2377–2384, 2016.

[427] S. Willi and A. Grundhöfer. Robust geometric self-calibration of generic multi-projector camera systems. In *IEEE International Symposium on Mixed and Augmented Reality*, pp. 42–51, 2017.

[428] J. Williamson, S. Robinson, C. Stewart, R. Murray-Smith, M. Jones, and S. Brewster. Social gravity: A virtual elastic tether for casual, privacy-preserving pedestrian rendezvous. In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems*, CHI '10, pp. 1485–1494. ACM, New York, NY, USA, 2010. doi: 10.1145/1753326.1753548

[429] A. Wilson, H. Benko, S. Izadi, and O. Hilliges. Steerable augmented reality with the beamatron. In *Proceedings of the 25th Annual ACM Symposium on User Interface Software and Technology*, UIST '12, p. 413–422. Association for Computing Machinery, New York, NY, USA, 2012. doi: 10.1145/2380116.2380169

[430] B. P. Wisely Babu, Z. Yan, M. Ye, and L. Ren. On exploiting per-pixel motion conflicts to extract secondary motions. In *IEEE International Symposium on Mixed and Augmented Reality*, pp. 46–56, 2018.

[431] D. Wolf, J. J. Dudley, and P. O. Kristensson. Performance envelopes of in-air direct and smartwatch indirect control for head-mounted augmented reality. In *2018 IEEE Conference on Virtual Reality and 3D User Interfaces (VR)*, pp. 347–354, 2018.

[432] G. Woo, A. Lippman, and R. Raskar. VRCodes: Unobtrusive and active visual codes for interaction by exploiting rolling shutter. In *IEEE International Symposium on Mixed and Augmented Reality*, pp. 59–64, 2012.

[433] H. Wu, H. Adams, G. Pointon, J. Stefanucci, S. Creem-Regehr, and B. Bodenheimer. Danger from the deep: A gap affordance study in augmented reality. In *2019 IEEE Conference on Virtual Reality and 3D User Interfaces (VR)*, pp. 1775–1779, 2019.

[434] Y. Wu, L. Chan, and W. Lin. Tangible and visible 3d object reconstruction in augmented reality. In *2019 IEEE International Symposium on Mixed and Augmented Reality (ISMAR)*, pp. 26–36, 2019.

[435] W. Xu, H. Liang, A. He, and Z. Wang. Pointing and selection methods for text entry in augmented reality head mounted displays. In *2019 IEEE International Symposium on Mixed and Augmented Reality (ISMAR)*, pp. 279–288, 2019.

[436] W. Xu, H.-N. Liang, Y. Zhao, D. Yu, and D. Monteiro. Dmove: Directional motion-based interaction for augmented reality head-mounted displays. In *Proceedings of the 2019 CHI Conference on Human Factors in Computing Systems*, CHI '19, p. 1–14. Association for Computing Machinery, New York, NY, USA, 2019. doi: 10.1145/3290605.3300674

[437] Y. Xu, S. Yang, W. Sun, L. Tan, K. Li, and H. Zhou. 3d virtual garment modeling from rgb images. In *2019 IEEE International Symposium on Mixed and Augmented Reality (ISMAR)*, pp. 37–45, 2019.

[438] Z. Yan, M. Ye, and L. Ren. Dense visual SLAM with probabilistic surfel map. *Transactions on Visualization and Computer Graphics*, 23(11):2389–2398, 2017.

[439] J. Yang, Y. Dai, H. Li, H. Gardner, and t. . S. b. . I. y. . . p. . . . Jia, Yunde.

[440] J. J. Yang and J. A. Landay. Infoled: Augmenting led indicator lights for device positioning and communication. In *Proceedings of the 32nd Annual ACM Symposium on User Interface Software and Technology*, UIST '19, p. 175–187. Association for Computing Machinery, New York, NY, USA, 2019. doi: 10.1145/3332165.3347954

[441] L. Yang, J. Normand, and G. Moreau. Local geometric consensus: A general purpose point pattern-based tracking algorithm. *Transactions on Visualization and Computer Graphics*, 21(11):1299–1308, 2015.

[442] L. Yang, J. Normand, and G. Moreau. Practical and precise projector-camera calibration. In *IEEE International Symposium on Mixed and Augmented Reality*, pp. 63–70, 2016.

[443] X. Yang and K.-T. Cheng. LDB: An ultra-fast feature for scalable augmented reality on mobile devices. In *IEEE International Symposium on Mixed and Augmented Reality*, pp. 49–57, 2012.

[444] G. Ye, A. State, and H. Fuchs. A practical multi-viewer tabletop autostereoscopic display. In *IEEE International Symposium on Mixed and Augmented Reality*, pp. 147–156, 2010.

[445] W. Yii, , and T. Drummond. Distributed visual processing for augmented reality. In *IEEE International Symposium on Mixed and Augmented Reality*, pp. 41–48, 2012.

[446] B. Yoon, H. Kim, G. A. Lee, M. Billinghurst, and W. Woo. The effect of avatar appearance on social presence in an augmented reality remote collaboration. In *2019 IEEE Conference on Virtual Reality and 3D User Interfaces (VR)*, pp. 547–556, 2019.

[447] D. Yu, K. Fan, H. Zhang, D. Monteiro, W. Xu, and H. Liang. Pizzatext: Text entry for virtual reality systems using dual thumbsticks. *Transactions on Visualization and Computer Graphics*, 24(11):2927–2935, 2018.

[448] M. Yu, H. Lakshman, and B. Girod. A framework to evaluate omnidirectional video coding schemes. In *IEEE International Symposium on Mixed and Augmented Reality*, pp. 31–36, 2015.

[449] Y.-T. Yue, Y.-L. Yang, G. Ren, and W. Wang. Scenectrl: Mixed reality enhancement via efficient scene editing. In *Proceedings of the 30th Annual ACM Symposium on User Interface Software and Technology*, UIST '17, p. 427–436. Association for Computing Machinery, New York, NY, USA, 2017. doi: 10.1145/3126594.3126601

[450] Y.-T. Yue, X. Zhang, Y. Yang, G. Ren, Y.-K. Choi, and W. Wang. Wiredraw: 3d wire sculpturing guided with mixed reality. In *Proceedings of the 2017 CHI Conference on Human Factors in Computing Systems*, CHI '17, pp. 3693–3704. ACM, New York, NY, USA, 2017. doi: 10.1145/3025453.3025792

[451] J. Zhang, A. Ogan, T. Liu, Y. Sung, and K. Chang. The influence of using augmented reality on textbook support for learners of different learning styles. In *IEEE International Symposium on Mixed and Augmented Reality*, pp. 107–114, 2016.

[452] R. Zhang and H. Hua. Effects of a retroreflective screen on depth perception in a head-mounted projection display. In *IEEE International Symposium on Mixed and Augmented Reality*, pp. 137–145, 2010.

[453] F. Zheng, D. Schmalstieg, and G. Welch. Pixel-wise closed-loop registration in video-based augmented reality. In *IEEE International Symposium on Mixed and Augmented Reality*, pp. 135–143, 2014.

[454] F. Zheng, T. Whitted, A. Lastra, P. Lincoln, A. State, A. Maimone, and H. Fuchs. Minimizing latency for augmented reality displays: Frames considered harmful. In *IEEE International Symposium on Mixed and Augmented Reality*, pp. 195–200, 2014.

[455] X. S. Zheng, C. Foucault, P. Matos da Silva, S. Dasari, T. Yang, and S. Goose. Eye-wearable technology for machine maintenance: Effects of display position and hands-free operation. In *Proceedings of the 33rd Annual ACM Conference on Human Factors in Computing Systems*, CHI '15, pp. 2125–2134. ACM, New York, NY, USA, 2015. doi: 10.1145/2702123.2702305

[456] N. Zioulis, A. Papachristou, D. Zarpalas, and P. Daras. Improving camera pose estimation via temporal EWA surfel splatting. In *IEEE International Symposium on Mixed and Augmented Reality*, pp. 1–10, 2017.

[457] S. Zollmann, D. Kalkofen, E. Mendez, and G. Reitmayr. Image-based ghostings for single layer occlusions in augmented reality. In *IEEE International Symposium on Mixed and Augmented Reality*, pp. 19–26, 2010.

[458] H. Álvarez, I. Aguinaga, and D. Borro. Providing guidance for maintenance operations using automatic markerless augmented reality system. In *IEEE International Symposium on Mixed and Augmented Reality*, pp. 181–190, 2011.