Laval Virtual Vision 2025
Blurring the lines between digital and physical worlds

M Pallot, S Richir

Lampa, Arts & Métiers ParisTech,
2 Bd du Ronceray, Angers, FRANCE

marc.pallot[a]ensam.eu, simon.richir[a]ensam.eu

www.ensam.eu

ABSTRACT

The recent evolution of immersive technologies, such as Virtual Reality (VR) and Augmented Reality (AR) as well as Mixed Reality (MR), leads to the emergence of new immersive experiences occurring in blended spaces constituted of both digital and physical worlds. This paper, based on the outcomes of the first edition of the Laval Virtual Seminar on Vision 2025, explores Immersive Virtual Environments (IVE), its related technologies, and more particularly addresses the potential increase of the immersion quality. It also discusses the main IVE elements and tries to foresee their key challenges and needs towards envisioned future developments.

1. INTRODUCTION

Recently, new immersive devices for VR applications, from very cheap cardboard head-up display style or other smartphone headsets up to more sophisticated but still pricey Head Mounted Displays (HMDs), pave the way toward democratizing immersive 360° experiences for every organization and consumer. Effectively, while several million of cardboard sets have already been distributed to early experimenters of VR applications, only thousands of new VR HMDs have been launched for developers and early adopters, such as gamers. The same applies to AR glasses, though, there isn't yet anything very cheap and it seems that the price depends on the capacity to display holograms overlaying objects on a real environment. Large media players and big brands already offer content and brand new immersive VR experiences for free reaching a large public that immediately get the 'wow' effect of being present in the middle of a story world instead of watching a video on a flat screen. The persuasive power of 360° experiences in immersive worlds will push organizations and people to soon be willing to pay for consuming more content and live new exciting immersive VR experiences.

Figure 1. *Laval Virtual 2016 – www.laval-virtual.org.*

Anyone visiting Laval Virtual (LV) exhibition this year (Figure 1) could easily observe the growing enthusiasm of visitors fighting on the booths having available HMDs for experiencing 360° VR immersion. Laval Virtual is now the largest European show in the field of immersive technologies (VR, AR, MR) with 145 exhibitors and 15,500 visitors in 2016. This year, LV inaugurated the "Laval Virtual Seminar on Vision 2025", a prospective

 ISBN 978-0-7049-1547-3

seminar that brings together international experts in immersive technologies and future industries. Its first edition has been held on 2016 March 21-22 at the 'Chateau de la Mazure', near the city of Laval, France. The invited "Visionaries" (Figure 2) worked together to foresee and imagine the future of immersive technologies and then create elements of a common "Laval Virtual Vision 2025". On the third day, March 23rd, which is also the opening day of the Laval Virtual exhibition and ACM VRIC'2016 conference, they presented their views and shared vision elements to 150 specialists from diverse Academic research fields and Industry sectors. Multidisciplinary teams of these specialists worked together on the 4th day (March 24th) via thematic workshops to turn the prospective vision outcomes into specific future development aspects. A plenary session, which was held on Friday, March 25th, presented the contributions of these workshops to the LV Vision 2025.

Figure 2. *Laval Virtual Seminar 2016 visionaries – from left: Dr Marc Pallot, Dr Skip Rizzo, Dr Dirk Reiner, Dr Oliver Bimber, Dr Carolina Cruz-Neira, Georges Karvelis, Christine Perey, Alexandre Godin and Dr Simon Richir.*

This paper explores an IVE structure, discusses immersion quality and reports about the outcomes of the Laval Virtual Seminar (LVS'2016) on Vision 2025 whose main goal is to identify key challenges and needs that could pave the way toward VR, AR and MR developments from medium to long term future. Participants (see their names in the Acknowledgements) of this first LVS edition are affiliated to Academic research institutes or Industry business units. They are recognised experts in their respective fields of research or advanced technology deployment.

2. INCREASING THE QUALITY OF IMMERSION & PRESENCE

There are very relevant quotes from Albert Einstein when thinking about the meaning of the concept of immersion: "*Reality is merely an illusion, albeit a very persistent one*"; "*Truth is what stands the test of experience*" and finally "*Put your hand on a hot stove for a minute, and it seems like an hour. Sit with a pretty girl for an hour, and it seems like a minute. THAT'S relativity*".

If the phenomenon of immersion has the capacity to turn an illusion into a persistent one, then, it becomes a reality for people that believe in experiences they live; and, most probably, because they love engaging situations in which the notion of time disappears. A dictionary tells us that immersion represents the state of being deeply engaged; like being fully absorbed by playing sport, known as being a tactical/sensory-motoric immersion; or solving a problem, known as being a strategic/cognitive immersion; or reading a captivating story or watching an exciting movie, known as being a narrative/emotional immersion (Ernest, 2004; Staffan & Holopainen, 2004; Pillai & al., 2013). These types of immersion make one's brain so busy that everything else around simply disappears. A pretty good way to measure the deepness to which a person is engaged is to observe whether the notion of time disappears as well as the whole external world. To make it short, one could argue that a 360° VR immersion bubble operates like a mind-blowing teleportation, instantaneously transporting a user in an existing remote place or a different world that is persistent enough to become another reality, even if it is a virtual one.

While VR is considered fully immersive because the real surrounding environment disappears, AR and MR look partly immersive because users still see their real environment on which digital (virtual) objects are overlaid; hence, augmenting the reality. Furthermore, MR provides the capacity to scan real objects or parts of the real environment and bring them into the digital (virtual) world; hence, augmenting also the virtuality.

Another consideration about immersive technologies, consists in making a distinction between passive immersion, seating and watching a 360° spherical scene wearing a HMD, and active immersion, almost freely walking in a 360° scene like in a Cave Automatic Virtual environment (CAVE) (Cruz-Neira et al., 1992) equipped with head and motion tracking. Cruz-Neira and colleagues (1992) have defined five main factors enhancing the quality of immersion in a CAVE, namely: 1) a view-centered perspective (head tracking), 2)

©2016 ICDVRAT; ISBN 978-0-7049-1547-3

panorama (surrounding the viewer with visuals), 3) body and physical representation (users' awareness of the interactive workspace's physical constraints), 4) intrusion (restricting the user's senses), 5) the field-of-view (the display portion users can observe without rotating their head, maximum 180°, practically 120°). From affordability point of view, there is a considerable cost difference between a HMD and a CAVE; though, nowadays, there are low cost CAVE solutions available on the market.

According to Cummings and Bailenson (2015), technologies to achieve quality immersive mediated environments are becoming more affordable, for example surround-screen VR display (Cruz-Neira et al., 2010), and less cumbersome. In fact, immersive technologies are intended to stimulate senses of users in a way that they feel present in a mediated virtual environment (Heeter, 1992; Gaggioli et al, 2003). The quality of the mediated immersion or Immersive Virtual Environments (IVE) relies on the number of stimulated senses, namely: vision (e.g. HMD, CAVE, and holographic display), auditory (e.g. surrounding sound) and tactile (e.g. haptic devices). They constitute the most frequently stimulated senses. The quality of the mediated immersion depends also on the user provided capacity to naturally interact and evolve (e.g. motion tracking, gesture recognition, omnidirectional treadmill) in such a virtual environment. Olfaction and gustation senses, are more rarely in use in IVE due to the fact that it is not necessarily mandatory to spread artificial flavors around and quite costly to realize for a limited increase of the immersion quality. Nevertheless, the stimulation of these two senses could become much more important depending on the nature of the immersive experience to be designed (e.g. perfume or wine based applications). However, the above-mentioned tactile sense depends on the somatosensory system that allows humans to experience different sensations, such as: touch, pressure, temperature, pain, posture (spatial location of body parts) and facial expression collectively called proprioception. Other sensations like movement, acceleration and balance depend also on the vestibular system (Brynie, 2009; Krantz, 2009). These sensations are often in play in the case of immersive training simulators delivering more effective trainings for accelerated and experiential Learning (Reiners, 2008), and exergame simulators for learning specific sport activities, such as jogging, golfing and skiing, by practicing in a social environment with indoor and outdoor players having different level of expertise (Pallot et al., 2013).

Immersive technologies often play with illusions like the 3D vision supported by stereoscopic display and glasses (passive or active) that provide a depth perception as an illusion of depth beyond the screen. Most of the stereoscopic approaches are based on two images separately sent to the user's left eye and right eye. The user's brain assembles these 2D images in order to get an illusion of 3D depth. Another type of immersive technology conveying a 3D visual illusion is the holographic display that doesn't necessitate wearing any glasses. The main consequence of playing with illusion is that it engenders brain or visual tiredness and sometimes even diffraction sickness that make the immersive experience uncomfortable. This is due to the constant brain adaptation when receiving contradictory stimulus from several senses. For example, a user is seated while playing a car race, in the scene the car is moving; hence, the brain should balance contradictory raw data during the multisensory integration process. In this case, the contradictory stimuli are on the one hand a visual and audio perceived motion and on the other hand a proprioception/vestibular perceived motionless. In contrast, the LightField (LF) technology is promising for both displays and imaging systems because LF is fully compatible with the natural human vision capabilities. According to Birklbauer and Bimber (2014), LF photography becomes increasingly practical, LF cameras are already available on the market (e.g. Lytro, Raytrix); however, they explain that obtaining spatial and directional consistence is not yet systematic for avoiding strong image artefacts when refocusing and changing perspective

The quality of immersive technologies is also due to the capacity to track body parts or objects, such as head tracking in HMDs that captures the head position for rotating the field-of-view in a 360° scene. Field-of-view, frame-rate, resolution and latency factors, often mentioned as Quality of Service (QoS) (Wu et al., 2009), play an important role in the measurable technical quality of compelling immersive experiences. However, empirical findings have shown that a system excelling in the measurable QoS factors could still fail to convince users adopting it due to a low score of the perceived Quality of User Experience (QoE) (Davis, 1989; Wu et al., 2009) or other User eXperience (UX) dimension factors such as the social or societal dimension (Pallot and Pawar, 2012).

For designing IVE, it is of paramount importance to understand how humans perceive and comprehend the world surrounding them through their senses and felt sensations from multi-sensory modalities and integration (Stein et al., 2009; Light, 2009). According to Light (2009), humans' eye is a complex structure whose only a small part of its tissues are intended to the photoreception process leading to vision through the light emitted or reflected by objects that could be perceived in the visual environment. He claims that vision is a dominant sense for human beings as they rely more on vision than any other special sense. It is also necessary to anticipate IVE induced symptoms, such as motion sickness, vertigo, dizziness, visual tiredness and nausea (Lawson, 2014). In some cases, IVE could be reversely used for vestibular or other post-traumatic rehabilitation (Kruger, 2011; Rizzo et al, 2015). Cummings and Bailenson (2015) argue that the highest quality of immersion of the IVE, the more likely users will feel present in the IVE and will perceived the mediated environment as a plausible space in which they feel located (Wirth et al., 2007). Based on the definition of presence from Wirth et al. (2007), Cummings and Bailenson came to the conclusion that the concept of presence is a two-dimensional construct comprising the user sense of self-location and perceived opportunities to interact with the IVE.

Figure 3 presents a tentative IVE structure composed of an Immersive (VR/AR/MR) Platform, including the Immersive (3D) Content, delivering the Immersive Experience to users. The resulting users' perceived immersive sensations and feelings are then evaluated through measured and user perceived factors of the Immersion Quality. The quality of platform immersiveness is deducted from the measured QoS technical factors (e.g. field-of-view, frame-rate, resolution and latency factors) and QoE (e.g. ease-of-use, usefulness, presence) of the Immersive Platform. The degree of immersiveness depends on the main goal of the immersive application and on the selection of immersive technologies.

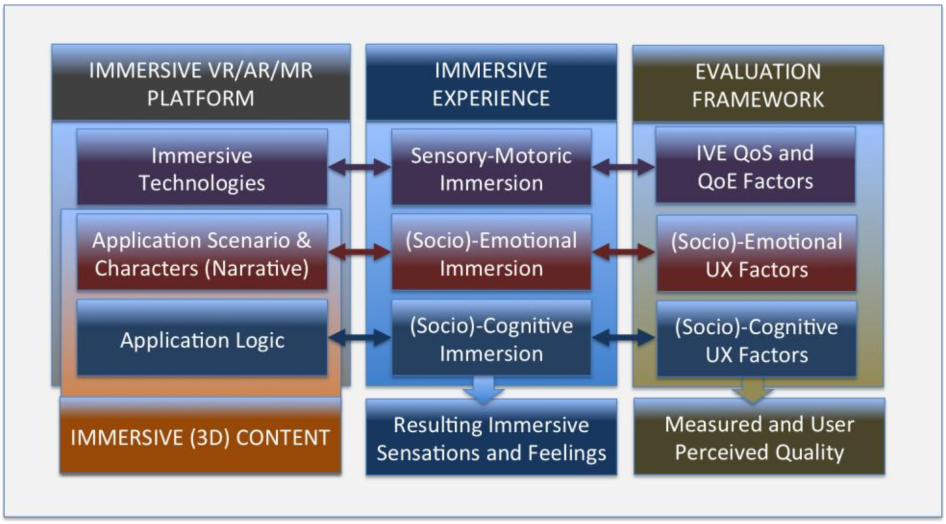

Figure 3. *Representation of an Immersive Virtual Environment (IVE).*

As for the evaluation framework of an immersive experience, the (socio)-emotional and (socio)-cognitive UX factors are envisioned in the Pallot et al (2013) extended QoE model of Wu (2009). For example, a ski training application could be a fully or partially immersive application. In the case of a fully immersive application, there are different possible technological solutions. It could be a VR based platform hosting a ski training application including a ski resort and skiing slopes 3D content for indoor ski practice (Figure 4). Hence, it is a fully immersive VR application that could be operated in a CAVE where the user wears stereoscopic 3D glasses, including head and gesture tracking, while practicing on a physical ski-training simulator animated by four hydraulic cylinders. Instead of using a CAVE, the user could simply wear a VR HMD. For sure, the cost is much lower with the HMD based solution compared to the one with the CAVE. Nonetheless, the resulting immersive experience will not necessarily be the same due to the physical environment blindness effect, which is generated when wearing the HMD, on the body movements for practicing on the physical ski simulator. The user's body responses, engendered by the perceptual layer as a reflex, for balancing the centre of gravity in order to avoid falling from the physical ski simulator depends on the received visual and vestibular-proprioception stimuli. While the visual stimulus is rather a perceived illusion as the user doesn't really move down the ski slope, the vestibular-proprioception stimuli look like real sensations due to the four hydraulic cylinders animating the physical ski simulator and transmitting the almost real feeling of the changing ski slope inclination including bumps. In our lab, we had to reverse the physical ski simulator in order to get the backside security bar that users can grab with their hands for preventing frontal falls. Otherwise, falling from the physical ski simulator is an extremely good indication of the user's level of immersion and engagement in the VR ski training activity.

In the case of a partially immersive application, the user simply see an avatar, controlled by a joystick, going down the ski slope in a VR application displayed on a flat screen. In another solution, the user wears ski AR goggles including head and motion tracking while practicing on a real ski slope. Hence, it is a partially immersive application because the user is still able to see the real surrounding environment while digital (virtual) objects are overlaid for adjusting body postures such as balancing the centre of gravity. Obviously, the resulting immersive experiences are not necessarily the same, especially from the sensory-motoric immersion point of view. While the quality of the sensory-motoric immersion will be lower compared to a fully immersive situation, the (socio)-emotional and (socio)-cognitive immersion could engender a higher immersion quality.

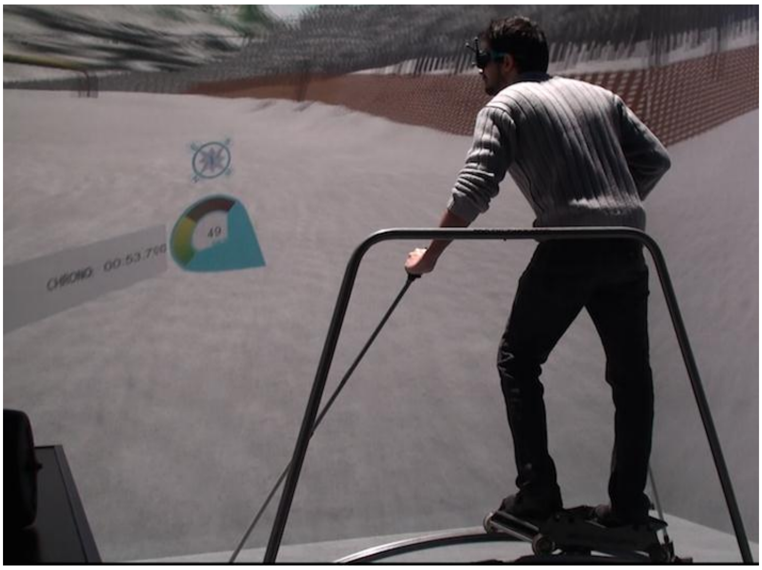

Figure 4. *3DLive European project – www.youtube.com/user/3DLIVEproject.*

3. KEY CHALLENGES

The first edition of the LV Seminar on Vision 2025, through brainstorming and world-café sessions, has allowed our working group to identify three Key challenges, namely: 1) improving the **quality of immersion** through the emergence of new immersive technologies; 2) easier creation of mind-blowing **immersive experiences**; 3) more natural **immersive platforms**.

3.1 Improving the Quality of Immersion

According to Cummings and Bailenson (2015), based on a meta-analysis of previous empirical work on immersive technologies and spatial presence for decades, tracking level, stereoscopy and field-of-view constitute the most prevalent features ensuring users feel physically present in IVEs. Participants of the LV Vision 2025 seminar have identified the following challenges to improve the immersion quality: 1) higher quality displays that reach human vision capabilities; 2) 4D imaging including enhanced tracking and 360° scene acquisition; 3) 4D displays including correct depth perception (accommodation);

These above described challenges imply the following needs:

- Increased display resolution for both small displays and projectors;
- Solve 3D disparity, convergence & accommodation, increased field of view (peripheral 120°);
- Promising light field displays with directional light per pixel;
- Possible for HMD but harder for large screens;
- Easy to realize with micro-lenses but needs extremely high resolution display;
- Other possible solutions, such as magic leap;
- High-resolution sensors.

3.2 Easier creation of immersive experiences

Participants of the LV Vision 2025 seminar have identified the following challenges to contribute to the easier creation of immersive experiences: 1) Wider Knowledge about Augmented, Virtual and Mixed Realities impact (human factors); 2) More accessible and reusable design of 3D & 360° content & experience; 3) Earlier ideas experimentation and continuous evaluation of user technology acceptance and solution adoption by users; 4) New skills & disciplines integrating multiple specialization (design, software, UI & UX, sensor engineering, art & gaming design).

These above identified challenges imply the following needs:

- Authoring Tools & New Skills;
- Guidelines for designing immersive (user) experience;
- Repository collecting good & bad examples of previous experiences;

- Automated XD quality check;
- Tools for rapid design & prototyping;
- Drag & drop approach with Lego style;
- Tools for experience evaluation;
- Device agnostic Tools, focus on UX and include behavior automation (AI);
- New curricula for Mastering immersive experiences (understand engagement, presence, motion sickness and complexity of interaction in 3D);
- New degrees & new job profiles.

3.3 More natural immersive platforms

Participants of the LV Vision 2025 seminar have identified the following challenges to contribute to more natural immersive platforms: 1) Higher immersive and sensing quality; 2) More accessible Design of human-tracking content & experience; 3) Automated behavior and user control; 4) Fulfill ethics, Security & privacy issues; 5) Wider Virtual human use cases.

These above identified challenges imply the following needs:

- Automated tutoring; virtual patient, companion, interviewer or coach; automated safety & quality control; teleportation, practice training;
- Authoring Tools for 3d agents (avatars or body reconstruction) with automated behavior (machine learning, database, persistence, range/domain, one-off);
- Authoring tools for designing virtual human use cases, the intensity of interaction, user control (pause/off/on) and user (immersive) experiences;
- Tools for sensing the real world with body gesture, hands & fingers motion, eye tracking, voice tone, contextual objects & space environment, physiological signals, facial emotions;
- Tools to design Natural User Interface;
- Tools to balance between technology, user and context (user experience);
- Imaging & physio tools for instant capture user environment and state of mind.

4. CONCLUSIONS AND FUTURE WORK

We explored a tentative IVE structure that could be operationalized and eventually standardized for whatever immersive VR, AR or MR applications. We also discussed the concept of immersion and related levels as well as notion of immersion quality that is included in the Evaluation Framework of this IVE structure. Finally, we presented the LVS'2016 identified key challenges and needs that will pave the way toward VR, AR and MR developments from medium to long-term future. It appears quite clearly that the Light-Field technology is an extremely promising 3D solution fully compatible with human vision capabilities for both displays and imaging systems that effectively capture and process 360° real scene (e.g. Lytro Immerge). Regarding other senses, there are new audio systems to capture and deliver 360° sound synchronised with the head tracking for delivering auditory space sensation in relation with the user's field-of-view. There are also new haptic technologies under development like an exoskeleton device for hands that delivers precise haptic feedback; a list is available on VR-Times (http://www.virtualrealitytimes.com/2015/03/13/list-of-haptic-controllers-virtual-reality/). The ultimate goal is to bring more stimuli for enhancing the immersive experience in order to make it more realistic.

Digi-Capital, a market advisor, forecasted in April 2015 that the VR/AR market will grow to $150B by 2020 and AR/MR devices (e.g. Hololens, Magic Leap) will replace the smartphone market because one could wear it anywhere and whatever the activity without obstructing the real environment or distracting from it; most probably, this forecast could come true when these partly immersive AR/MR devices will become lighter, closer to the natural humans' vision (e.g. Light-Field technology), social and privacy principles, as well as more affordable. In this forecast report, it was said "*AR, meanwhile, can be fun for games, but not as much fun as VR when true immersion is required*". In contrast, looking at the current success of the AR 'Pokémon GO' mobile-app location-based game (Figure 5), while the sensory-motoric immersion is mainly based on the dominant sense of vision for capturing virtual entities, its proved viral propagation is, most probably, rather due to the other two levels of Immersion than to its felt presence.

As for future work, up-coming LVS editions will allow to continuously refine the draft vision 2025 while introducing new emerging immersive technologies and approaches facilitating mind-blowing immersive experiences. An on-going second paper will report the contribution of the VRIC'2016 workshops to the first draft of the LV Vision 2025. We just started this fascinating LV Vision work as an open co-creation community assembling experts and specialists from different disciplines; we do not pretend to know what the future of immersive technologies (VR/AR/MR) is going to be but we do believe in what said Alan Kay (1971), "*The Best way to predict the future is to invent it!*".

The LVS second edition will be held on 2017 March 20-21 again at the 'Chateau de la Mazure', near the city of Laval, France; just before the opening day of the Laval Virtual exhibition and ACM VRIC'2017 conference and workshops that will be held from 22nd to 25th of March 2017. This second edition will bring an opportunity to further discuss and refine the outcomes of the first edition and to consider other emerging immersive technologies as well as new immersive/engagement approaches.

Figure 5. *Pokemon Go, great worldwide success of Augmented Reality technology.*

Acknowledgements: Authors wish to acknowledge their gratitude and appreciation to the LVS'2016 invited visionaries, namely (alphabetic order): Dr Oliver Bimber, Dr Carolina Cruz-Neira, Alexandre Godin, Georges Karvelis, Christine Perey, Dr Dirk Reiner, and Dr Skip Rizzo**,** for their valuable contributions to the success of the first edition of the Laval Virtual Vision 2025.

5. REFERENCES

Adams, E, (2004), "Postmodernism and the Three Types of Immersion". Gamasutra. http://www.gamasutra.com/view/feature/130531/the_designers_notebook_.php

Birklbauer, C. and Bimber, O., (2014), Panorama Light-Field Imaging, Eurographics 2014 (Computer Graphics Forum), 33(2), 43-52, 2014.

Brynie, F.H., (2009), Brain Sense: The Science of the Senses and How We Process the World Around Us. American Management Association.

Cummings, J.J., Bailenson, J.N., (2015), How immersive is enough? A meta-analysis of the effect of immersive technology on user presence. Media Psychology. 1-38.

Cruz-Neira, C, Sandin, DJ, DeFanti, TA, Kenyon, RV and Hart. JC, (1992), "The CAVE: Audio Visual Experience Automatic Virtual Environment", Communications of the ACM, vol. 35(6), 1992, pp. 64–72. DOI:10.1145/129888.129892

Cruz-Neira, C, Reiners, D, Springer, JP, (2010), An affordable surround-screen virtual reality display, in Journal of the Society for Information Display, 2010.

Davis, F. D., (1989), Perceived usefulness, ease of use, and usage of information technology: a replication. MIS Quarterly, 13(3):319–340.

Gaggioli, A, Bassi, M and Delle Fave, A, (2003), "Quality of experience in virtual environments," Ios Press, Being There: Concepts, effects and measurement of user presence in synthetic environments, 2003, pp. 122–132.

Heeter, C, (1992), "Being there: the subjective experience of presence," Presence: Teleoperators and Virtual Environments, vol. 1, no. 2, pp. 262–271, May 1992.

Krantz, J., (2009), Experiencing Sensation and Perception. Pearson Education, Limited, 2009. p. 12.3.

Krueger, WW, (2011), "Controlling motion sickness and spatial disorientation and enhancing vestibular rehabilitation with a user-worn see-through display," Laryngoscope 121 (Suppl 2.): 17–35. doi:10.1002/lary.21373. PMID 21181963. Retrieved 15 July 2014.

Lawson, B. D., (2014), Motion sickness symptomatology and origins. Handbook of Virtual Environments: Design, Implementation, and Applications, 531-599.

Light, D. B., (2009), *The Human Body: How it Works – The Special Senses*, Chelsea Publ., Philadelphia, PA.

Pallot, M, Poussard, B, Christmann, O and Richir, S, (2013), "Augmented Sport: Exploring Collective User Experience," presented at the ACM Virtual Reality International Conference VRIC'2013.

Pallot, M., and Pawar, K. S., (2012), A Holistic Model of User Experience for Living Lab Experiential Design. In Proceedings of the 18th International Conference on Engineering, Technology and Innovation, ICE'2012 "Innovation by Collaboration and Entrepreneurial Partnerships", Munich, Germany, 18-20 June 2012, DOI= http://dx.doi.org/10.1109/ICE.2012.6297648

Pillai, J. S., Schmidt, C., & Richir, S. (2013). "Achieving Presence through Evoked Reality". *Frontiers in Psychology*, 4.

Reiners, D, (2008), *Virtual Training for Industrial Applications*, in Schmorrow, Cohn, Nicholson, The Handbook of Virtual Environment Training: Understanding, Predicting and Implementing Effective Training Solutions for Accelerated and Experiential Learning, Praeger Security International, 2008.

Rizzo, A., Cukor, J, Gerardi, M, Alley, S, Reist, C, Roy, M, Rothbaum, BO, Difede, JA, (2015), Virtual Reality Exposure for PTSD Due to Military Combat and Terrorist Attacks, In Journal of Contemporary Psychotherapy, 2015.

Staffan, B, Holopainen, J, (2004), Patterns In Game Design. Charles River Media. p. 206. ISBN 1-58450-354-8.

Stein, BE.; Stanford, TR.; Rowland, BA., (2009), "The neural basis of multisensory integration in the midbrain: its organization and maturation.". Hear Res 258 (1-2): 4–15.

Wirth, W., Hartmann, T., Böcking, S., Vorderer, P., Klimmt, C., Schramm, H., & Jäncke, P., (2007), A process model of the formation of spatial presence experiences. Media Psychology, 9, 493–525.

Wu, W, Arefin, A, Rivas, R, Nahrstedt, K, Sheppard, R and Yang, Z, (2009), "Quality of experience in distributed interactive multimedia environments: toward a theoretical framework," presented at the ACM Multimedia Conference 2009, New York, New York, USA, 2009, pp. 481–490.