7 Conclusion

3-D video capture and display technologies have experienced rapid growth and commercial success during the last decade. Driven by the powerful vision of being able to communicate in 3-D, the integration of 3-D video and communication technologies are underway. Immersive communication applications provide more natural conditions for effective human interaction. 3-D video communication is demanding due to the stringent requirements on quality and the enormous amounts of data involved. 3D video has become ever closer to the users due to the technological advancement of related technologies. This book has viewed the state of the art of 3D video technologies, ranging from 3D video capture to display. Different 3D video scene representations and capturing techniques are presented and the advantages and disadvantages of the colour plus depth map representation, which is the selected representation for the experiments are discussed. Next, the compression techniques for stereoscopic video are described. This also elaborates on principles of classical 2D video coding approaches and scalable video coding. The transmission technologies are presented with more focus on 3D video over IP networks. Furthermore, this elaborates on error resilient and error concealments methods applicable for stereoscopic video. The viewing methods for 3D video are getting popular and becoming more affordable. The state of the art 3D video display techniques are discussed including latest Autostereoscopic display techniques. Finally, the quality issues of 3D video are explored and formal methodologies of evaluating emerging 3D video application scenarios are presented.

7.1 Areas for future research

This section describes some of the issues, which remain to be tackled in the provision of 3-D communication services and outlines the author's view of the future of 3-D multimedia communications.

Efficient encoding approaches are proposed for colour plus depth stereoscopic video applications in Chapter 3. The conventional block-based coding algorithms are utilized to encode both colour and depth image sequences in the proposed methods. Motion parameters for colour and depth map video are estimated using 2D motion search algorithms. However, 2D motion estimations will not account for all the motion in the depth images. For example, the motion in the direction of z-axis will not be tackled by the 2D motion estimation process. Therefore, dedicated 3-D motion estimation algorithms can be designed to get better compression efficiency than the use of 2D motion search algorithms.

Scalable video encoding approaches for 3D video as described in Chapter 3 can be effectively used in reducing the storage and bandwidth required for 3-D video applications without any degradation to perceived quality. This can be further extended to support bandwidth variations in the network adaptively. Closed-loop rate adaptation algorithms can be designed to optimize the 3-D video quality under changing network conditions. Furthermore, the asymmetric coding methods can be extended to design Joint Source Channel Coding (JSCC) methods. For instance, when channel conditions are bad, the depth image can be encoded with reduced resolution to allow for more channel protection to be applied to the 3-D stream. The full resolution depth images can be sent with reduced protection at good channel conditions. In case of a backward compatible 3-D video service, the transmitter can only send the colour video stream with full protection at bad channel conditions by neglecting the associated depth stream.

Even though coding of colour plus depth based stereoscopic video is considered in this book, the proposed techniques can also be applied to emerging multi-view plus depth map representation. Unlike stereoscopic video, the demand for system resources (e.g. storage and bandwidth) is enormous for multi-view video applications. Therefore, the proposed encoding approaches can be extended to design bandwidth friendly multi-view video applications.

Unequal error protection (UEP) method for backward compatible 3-D video transmission over WiMAX is proposed by the author in [133]. The allocation of transmission power is varied to support unequal error protection for colour plus depth video. Even though the quality is optimized in this approach the transmission power can also be optimized with the proposed method. Furthermore, this method can also be extended to multi-view video applications. For example, selected number of views can be highly protected based on the user's head position. In addition, the use of transmission power to provide unequal protection would be more suitable for multi-view applications, because adding redundancies for protection may not be the best way to provide protection due to the high bandwidth demand of these applications.

3-D video distribution in a home environment is also addressed by the authors in [132]. A prioritization scheme is proposed for 3-D video distribution over wireless network based on their importance towards better perceptual quality [132]. This work can be further extended to optimize 3-D video quality adaptively based on the type of network traffic in the premises. For instance, when there is not much video traffic, both colour and depth streams can be mapped to a high priority traffic class whereas depth stream is mapped to a lower priority traffic class compared to that of the colour stream when the network is flooded with video traffic. The multi-view plus depth video distribution can also be prioritized based on the proposed prioritization scheme. For example, the important views which are necessary to be able to render other views can be allocated a higher priority traffic class to optimize the rendered 3-D video quality.

Depth error concealment algorithm is proposed for colour plus depth stereoscopic video by the author in [131]. This method exploits the existing correlation between colour and depth map sequences. The motion correlation between colour and depth map frames may not be high at all time instances. Therefore, the proposed method can be joined with conventional frame concealment algorithms (e.g. frame copy) to achieve better results. Accurate depth maps are required to render novel views in multi-view plus depth 3-D video. Hence, the proposed method can be utilized to render good quality novel views for multi-view applications.