



























Fig. 10. (a) - numerical reconstruction of the phase object in the micrometer range from holographic data after applying the Gerchberg-Saxton algorithm to modify phase distribution; (b) - optical reconstruction at  $\lambda_2 = 532$  nm with a single SLM after incorporation of a digital lens at the SLM plane; the size of the reconstructed 3D shape is 6 mm.

## 6. Conclusion

3D holographic display of transparent objects is achieved. The object may have a constant or varying refractive index. Different visualization modes are designed, implemented and tested. In one mode, the 3D point cloud structure is constructed from captured holographic data, and then the computer generated holograms of this 3D structure are formed and holographically displayed using a circular holographic display consisting of multiple phase-only SLMs. This display provides seamless viewing of the 3D point-cloud structure from continuous directions within a rather large viewing angle [13]. In another mode, a real-life viewing through transparent objects is imitated. An artificial planar textured pattern is generated and inserted as the background of the uniform refractive index transparent object to be visualized. Diffraction signals corresponding to the combined 3D scene (planar textured background and the 3D transparent object in front of it) are computed and fed into a phase-only SLM for holographic reconstruction. In the third approach, the captured holographic data related to a 3D transparent object is directly used to retrieve the complex amplitude of a diffracted light distribution as it passes and exits the transparent object. It is observed that only the phase component of this complex amplitude, obtained by simply discarding the magnitude, does not provide sufficient quality 3D reconstructions using a phase-only SLM as the holographic display device. Therefore, a more sophisticated procedure based on the iterative Gerchberg-Saxton algorithm is employed to compute the phase distribution to be written on the phase-only SLM. As a consequence, a satisfactory naked-eye 3D holographic display of a transparent (varying index) micro object is achieved, with a magnification of about 250.

## Acknowledgments

This work is supported by the European Community (EC) within the Seventh Framework Programme (FP7) under Grant 216105 with the acronym Real 3D. This work was partly supported by the IT R&D program of MSIP/KEIT [K10045289, Development of Virtual camera system with real-like contents].