Chapter 6

Summary and Conclusion

We have calculated the local intensity distribution of light after passage through a scattering region whose index of refraction is modulated by a sound wave. The phase of the rays is calculated by tracing their optical path length. The sound wave is represented by a periodic phase modulation of the medium. We could successfully simulate the occurrence of scattering maxima if the Bragg condition is fulfilled. The appearance of higher order "diffraction peaks" and even the validity of the Bragg condition were shown in the simulation, when only scattering processes in the layer with the sound field were considered. In most case only rays were investigated, which experience at least one scattering processes in the sound field. We obtained by modified Monte Carlo method that the magnitude of the Bragg peak, which appears only due to the constructive interference of the phase modulated light, is governed by the thickness of the sound field, the scattering coefficient, the anisotropy coefficient of the medium and the number of launched photons. The results presented in the section 5.6 show that our modified Monte Carlo Method based only on scattering processes can successfully simulate the light diffraction on a plane sound wave. The results from the numerical experiment show good agreement with theoretical curves, when the light beam incidents orthogonal on the sound field and when the light incidents with Bragg angle, section 5.6. The
simulation reveals that the light scattered only on the optical scatterers in the region with the sound field shows behavior similar to light scattering on the plane sound wave in transparent homogeneous medium.

First we neglected scattering processes outside of the sound wave. Scattering outside of the sound wave would add noise. Qualitatively, we do not expect much influence of scattering processes outside of the sound wave. The main purpose of this project is to develop method that can detect among diffused transmitted light the light tagged by the ultrasound wave. This effect permits that a scattered light that has traversed a specific localized region can be distinguished from all other scattered light. In section 5.8 we extended to model to the treatment of frequency shift included by the Doppler effect. We introduced a frequency filter in our simulation. Its function is to detect rays with frequencies shifted by the sound wave. In the model presented here this filter is located in the detector plane, and the intensity distribution of the transmitted modulated light is calculated only for the light "tagged" by the sound wave. Results presented in section 5.8 show that the peak simulated with the frequency filter have the same behavior as the Bragg peak obtained only due constructive interference of the scattered light.

The next step was to add scattering processes before and after the sound, section 5.9. The simulations were carried out for the various width of the sound field and different optical properties of the turbid medium. The distance between the source plane and the sound beam is also varied. We expect that with increasing the photon number the simulation results for the scattering outside the sound approach to the results obtained without scattering. We should point out that when scattering is included in the simulation the number of the launched photons in medium sufficient increases and as consequence the computational time increases too.

In our project the modified Monte Carlo modeling of the light propagation in a turbid medium with the layer contains the sound plane wave was developed. It was shown that among diffused transmitted light can be detected the light tagged by the ultrasound wave. This effect gives oppor-
tunity to distinguish from all scattered light, the light that has traversed a specific localized region.