Abstract

This thesis addresses the ground penetrating radar (GPR) high-resolution imaging generation by utilizing the selected probing signals.

The signal bandwidth is the crucial radar parameter influencing the range resolution. In order to collect information concerning the properties of the centimeter-sized objects, such as anti-personnel landmines, most GPR systems use high-voltage very narrow pulses with nanoseconds duration. Besides the difficult signal generation, the high-speed analog-to-digital converters are required. Another approach to ensure high bandwidth of radar signal is the application of the stepped frequency (SF) modulation. It consists in transmitting narrowband signals at different frequencies and significantly reduces hardware requirements. The most popular SF probing signal in the GPR technique is the stepped-frequency continuous wave (SFCW) waveform.

This dissertation is focused on SF signals less frequent use and not used yet in the GPR systems. The main emphasis was on signal synthesis via angle modulated subpulses. In order to verify the correctness of theoretical assumptions, numerous computer simulations including finite difference time domain (FDTD) method were carried out. The real properties of the soil were taken into account. A large part of the considerations concerns a model of the shallow buried anti-personnel landmine. The proposed signals were also verified in simple software defined radar prototype.

The results confirm the possibility of obtaining high-resolution GPR imaging of shallow buried objects by utilizing the SF signal with angle-modulated subpulses.