

Figure 1. Downward looking laser Doppler vibrometer (LDV) based acoustic-to-seismic coupling landmine detection system in a field environment. The LDV head is mounted on a vehicle 3.5 meters above the ground. The laser beam is focused downwards onto the ground surface. Two loudspeakers in front of the vehicle wheels radiate acoustic waves towards the road surface.

Figure 3. Magnitude spectra measured by laser beam of the LDV based A/S landmine system. The sound source radiates pseudo-random noise covering the frequency range between 80 Hz and 260Hz. Magnitude spectra were measured on individual grid points marked in Fig. 2(a).

Figure 4. Forward-looking laser Doppler vibrometer based acoustic-to-seismic coupling landmine detection system in field environment. The laser beam is focused forwards onto the middle of the road shown on the right side of the photo.

Figure 2. Stop-and-stare scanning results. A plastic VS 2.2 anti-tank landmine buried 7 cm deep in a U.S. Army test lane. (a) A grid of 16 by 16 points covering a road patch of 1m by 1m. The laser beam stops on each grid point on the ground surface to measure the surface velocity. A dot-line circle indicates the location of the target. The color scale is in (b). (b) Color-coded 3D presentation.

Figure 5. Beam angle effect in the forward-looking landmine detection mode. 90 degrees corresponds to the downward-looking scenario. As the beam (grazing) angle to the ground surface decreases, the magnitude velocity on top of a mine decreases as well, while the averaged background velocity changes insignificantly.

Figure 7. Scanning results using a moving laser beam over a buried VS 2.2 anti-tank mine buried (a) Stop-and-stare scanning results. (b) Scanning result at 0.4 m/s moving speed. (c) Scanning result at 0.8 m/s moving speed. (d) Scanning result at 1.6 m/s moving speed.

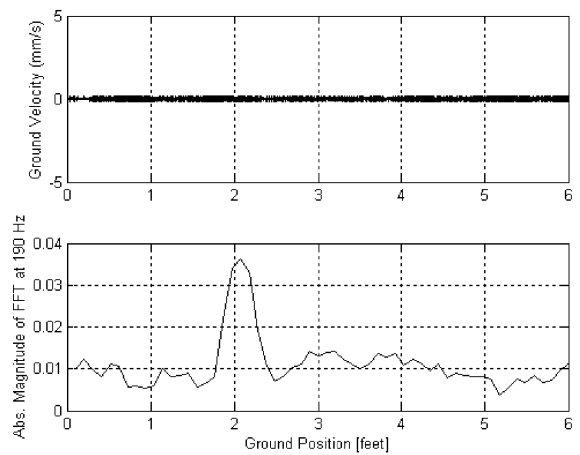


Figure 6. Moving beam scanning an area. The beam moves continuously across horizontal lines with a constant speed while stepping down when the beam arrives at the edge of the pre-defined area. The instantaneous velocity response on the ground surface is measured by the moving laser beam.

Figure 8. Field results achieved using a single-beam laser Doppler vibrometer mounted on a forward moving cart. Upper graph: surface vibration response in time-domain. Lower graph: RMS value of magnitude response evaluated in frequency domain.