recent developments in laser-acoustic detection of buried landmines

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Laser-acoustic detection of buried landmines is based on excitation of mechanical vibrations of the ground and remote vibration imaging of the ground surface with a laser vibrometer. Airborne sound created by a loudspeaker, or seismic waves created by a mechanical shaker can be used for ground vibration excitation. A buried landmine is detected by an abnormality in the vibration image of the ground surface caused by the landmine mechanical resonances and a difference in compliance between the landmine and the surrounding soil. Effectiveness of the laser-acoustic detection method largely depends on the performance of the laser vibration sensor. A scanning single-beam laser Doppler vibrometer initially used for laser-acoustic detection requires a lot of time, more than three minutes, for vibration imaging of the interrogated area due to point-by-point scanning process. Multi-beam laser Doppler vibrometers are able to reduce the time of measurements down to twenty seconds. Both, single-beam and multi-beam vibrometers are sensitive to the motion of the vibrometer itself, which limits their operation to a stationary platform. In order to overcome this limitation of traditional laser Doppler vibrometers we developed a Laser Multi Beam Differential Interferometric Sensor (LAMBDIS). The LAMBDIS has low sensitivity to the sensor motion, that allows for vibration imaging of the ground surface and detection of buried objects from a moving vehicle. The LAMBDIS was further enhanced to provide real-time measurements of the vibration velocity difference between points on the ground illuminated with a linear array of laser beams. The sensor creates a real-time vibration image of the ground area either by scanning the array of beams over the area from a stationary vehicle, or by moving the vehicle. Field experiments on detection of buried objects were conducted by using the LAMBDIS mounted on a vehicle with laser beams looking forward at a grazing angle to the ground. The experiments were conducted for both ways of ground vibration excitation: airborne sound and seismic waves. The field experiments demonstrated the ability of LAMBDIS to detect buried objects in real time from a moving as well as a stationary vehicle.