Active Hyperspectral Lidar

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We have developed a prototype active hyperspectral LiDAR and investigated its potential for remote sensing applications. The prototype is based on the supercontinuum laser technology, which produces laser pulses with continuous spectrum. The backscatter of these pulses can be detected with several spectral bands, thus creating hyperspectral intensity and range information. We present our prototype instrument and preliminary measurement results. The instrument consists of three major components: the supercontinuum laser source, optomechanical detector assembly, and an eight channel 1GS/s analog to digital converter. Backscattered light from the target is passed through a spectrograph to a 16 element avalanche photodiode array. The array transforms the spectrally separated light to analog voltage waveforms, each containing the time resolved backscatter intensity of one spectral band. With current configuration seven bands of 20–30 nm FWHM can be detected simultaneously within distance range of 2–15 meters. This setup allows us to choose the most interesting bands for any given application. With our data more specialized instruments, with multiple monochrome lasers, can be evaluated cost effectively and quickly. Also the data allows much easier data classification compared to traditional monochrome data, since properties like normalized difference vegetation index (NDVI) can be calculated directly from the dataset.

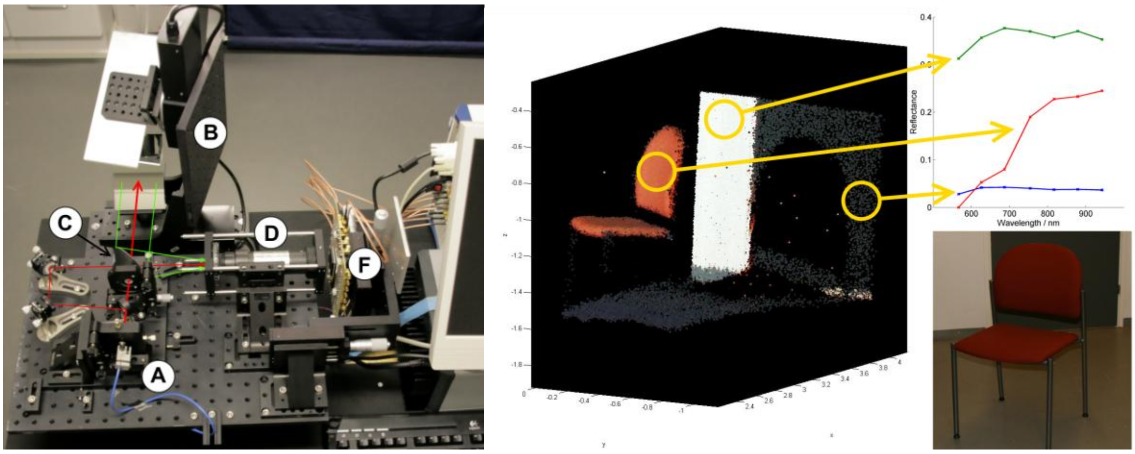

Figure 1. Left: Laser pulse is fed through an optical fiber (A) to 2D rotating scanner (B). The return pulse is collected using an off axis parabolic mirror (C), which is focused to a spectrograph (D). The spectrum of the pulse is converted to analog waveforms with a 16 element avalanche photo diode array. Middle: 3D point cloud of an office chair. The point colors are based on the measured reflectance (R = 815nm, G = 685nm, B = 625nm). Top right: spectra of three different surfaces: White wall, red chair fabric, and gray door. Bottom right: an image of the target from the viewpoint of the scanner.