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TITLE: Field Deployments of DWEL, A Dual-Wavelength Echidna Lidar

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ABSTRACT BODY: We describe the construction and operation of a terrestrial scanning lidar used for automated retrieval of forest structure. The Dual Wavelength Echidna® Lidar (DWEL) distinguishes between leaf hits and those of trunks and branches by using simultaneous, co-axial laser pulses at 1548 nm, where leaf water content produces strong absorption, and at 1064 nm where leaves and trunks have similar reflectances. The DWEL instrument obtains three-dimensional locations and characteristics of scattering events by using an altitudinal scan mirror on an azimuthal rotating mount along with full waveform digitization.

The instrument has seen two successful field deployments: to the Sierra National Forest, California in June of 2013 and to both the Karawatha Forest Park and Brisbane Forest Park near Brisbane, Australia in July/August 2013 as part of the Terrestrial Laser Scanner International Interest Group (TLSIIG) conference. Measurements of tree leaves, branches, and trunks were successfully made. Panels of known reflectance were used to calibrate and characterize the back scattered waveforms in the field. Preliminary maximum range measurements were shown to be over 75 meters for both wavelengths.

To obtain accurate waveform data, the two lasers are triggered simultaneously and each has a full-width-half-max length of less than 10 meters. The light is then collimated and expanded to a diameter of 6 mm before diverging in user-selectable optics with divergences of either 1.25- or 2.5-mrad enabling scan resolutions of 1- and 2-mrad. The durations of complete scans are approximately 164 and 41 minutes, respectively. Mirrors and dichroic filters co-align the two NIR wavelength laser beams along with a continuous-wave green marker laser. The outgoing beams are directed by a rotating 10 cm scan mirror with effective field of view of ±110 degrees attitudinally while the instrument itself rotates for an effective azimuthal field of view of 360 degrees. Optical encoders in both planes provide at least 15-bit precision per rotation. The back-scattered return signal arriving at the scan mirror enters a 10-cm Newtonian-Nasmyth telescope and is split using a dichroic beamsplitter and narrow band pass filters. InGaAs photodiodes measure the return signals at each wavelength which are sampled at 2 gigasamples per second with 10-bit precision. Waveform and housekeeping data are first collected by an on-board compactPCI single-board computer before being transmitted live via Ethernet to a separate field PC. The required 115 W of power is supplied by high-density lithium ion batteries which together with the instrument bring the total weight to around 21 kg. The instrument has been designed to be eye-safe.

In this presentation we will describe the features of the instrument along with data collected from the

field campaigns. This work was made possible by the US National Science Foundation under grant MRI-0923389.

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