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Shot Noise and Fiber Amplifier Effects in Photonic-Doppler Velocimetry Systems EDWARD KIRK MILLER, ERIC LARSON, KEVIN LEE, NNSS / NSTec — We present theoretical and experimental data to show the effects of shot noise and erbium-doped fiber amplifiers (EDFA's) on the achievable dynamic range of photonic-Doppler velocimetry (PDV) systems. We show that many common system configurations are very nearly shot noise limited. Heterodyne gain from strong local-oscillator (LO) light creates a signal amplitude that can be recorded on high-speed digitizers, and the shot noise from the LO sets the system noise floor above the levels of electronic noise in the photoreceiver and digitizer. We show that boosting weak signal returns using an EDFA creates noise in the same proportion that it increases signal, leaving the signal-to-noise ratio (SNR) unchanged. Amplified spontaneous emission (ASE) from the EDFA, when mixed with the LO light, creates a noise term proportional to the LO shot noise and to the EDFA gain. The net result is that EDFA's are useful for boosting heterodyne signal levels for recording, and they can be used to boost weak return light before lossy components, but they do not improve the fundamental SNR of the system.

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