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## Modeling and simulation of VCSELs noise and its influence on noise performance of RF fiber links

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### Abstract

In this paper, we present numerical simulations of the dynamics and noise of directly modulated vertical-cavity surface-emitting lasers (VCSELs) as primary light sources in RF links. Contribution of the VCSEL noise to the noise performance of the RF link is evaluated in terms of the noise figure. The VCSEL characteristics are investigated under a variety of conditions, including CW operation and sinusoidal modulation. Both single and two transverse-mode oscillations of VCSELs are studied. The obtained results show that the frequency spectra of the relative intensity noise exhibit peaks at the mode-competition frequency, the modulation frequency and the higher harmonics. The low-frequency level of relative intensity noise is minimum when the modulated VCSEL signal is continuous and uniform, but is pronounced when the signal is pulsing and non-uniform. The noise level of the two-mode VCSELs is almost 20 dB/Hz higher than that of the single-mode VCSEL. The noise factor of the fiber link decreases with the increase of both the modulation frequency and the depth. The contribution of the VCSEL noise to the noise factor of the fiber link is much greater than that of the photodiode. (C) 2013 Elsevier Ltd. All rights reserved.

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