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Influence of Strong Optical Feedback on Frequency Chirp and Lineshape Broadening in High-Speed Semiconductor Laser

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Abstract : Directly-modulated semiconductor lasers, including edge-emitting and vertical-cavity surface-emitting lasers, have received considerable interest recently for use in data transmitters in cost-effective high-speed data centers, metro, and access networks. Optical feedback has been proved as an efficient technique to boost the modulation bandwidth and enhance the speed of the semiconductor laser. However, both the laser linewidth and frequency chirping in directly-modulated lasers are sensitive to both intensity modulation and optical feedback. These effects along width fiber dispersion affect the transmission bit rate and distance in single-mode fiber links. In this work, we continue our recent research on directly-modulated semiconductor lasers with modulation bandwidth in the millimeter-wave band by introducing simultaneous modeling and simulations on both the frequency chirping and lineshape broadening. The lasers are operating under strong optical feedback. The model takes into account the multiple reflections of laser reflections of laser radiation in the external cavity. The analyses are given in terms of the chirp-to-modulated power ratio, and the results are shown for the possible dynamic states of continuous wave, period-1 oscillation, and chaos.

Keywords : chirp, linewidth, optical feedback, semiconductor laser
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