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Instabilities and Bifurcations of a DFB Laser Frequency-Stabilized by a High-Finesse Resonator

V. Tronciu, H. Wenzel, H. J. Wünsche

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Abstract

Recently reported miniature configurations with semiconductor distributed feedback lasers under resonant feedback are considered theoretically. Limiting instabilities and bifurcations are systematically explored by combining the theory of chirp reduction and a bifurcation analysis. It is shown that the regime of optimal chirp reduction also exhibits the best local stability. It suffers only from undamping of relaxation oscillations in a finite interval of feedback strength. The existence of a separate strong-feedback regime with high stability is consistent with the two experiments available so far. We regard this feature as a generic specificum of miniature configurations not known from large-scale setups. This regime can open new prospects for applications of compact frequency-stabilized semiconductor lasers with extremely low noise and small line width.