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# Multi-Level Simulation of VCSEL Devices and Packages in CFD-ACE+ Environment

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This paper presents an integrated software package and a comprehensive open environment, CFD-ACE+, for multi-disciplinary, multi-scale design of VCSEL devices, packages and complete photonic microsystems. It combines simulation tools for: device level physics (electrical, optical, thermal) of VCSELs, coupled circuit-package electric thermo-mechanical model, and wave optics model for free-space link with optical components. Two VCSEL device models have been implemented: an approximate semi analytical (electro-thermo-optics) model and high-fidelity drift-diffusion model linked with material gain and optics. A novel concept of circuit-package model has been developed for thermal-mechanical-optical design of optoelectronic packages. Circuit level models of VCSELs are “embedded” in a 3D package level model. Two-way coupling between thermo-mechanical and electric model is used to study thermal crosstalk and optical tolerancing. Optical coupling between VCSELs and receivers (photodetectors, fibers) is computed with the wave optics module in CFD-ACE+. It uses 3D girdles technique for wave optics simulations of optical beams propagating between optical components (VCSEL, lenses, mirrors, photodetectors). The paper will present technical details of the models and selected simulation results for three level of design: device, package and FSOI.

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