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Modeling Q-switched Laser Dynamics by State Space Methods
LAMEKA BOOKER, IKECHUKWU UME, MAKHIN THITSA, Old Dominion University — Q-switched lasers are prevalent in applications that require high intensity laser in ultra-short pulses. In a solid state laser Q-switching regime, the laser rate equations are a set of nonlinear coupled differential equations involving photon flux ϕ_a, instantaneous population inversion density n_s, and the absorption center density n_a. In this paper, the Q-switched laser is modeled by a system theoretic approach called state space method, where the three physical quantities: ϕ_a, n_a, and n_s are defined as the state variables of the system, the modulation function of the cavity losses, $\alpha(t)$ as the input function, and the laser output power as the output function of the system. First the system is Taylor linearized and the linearized system is simulated by MATLAB Simulink software. The full nonlinear system is also simulated in Simulink. The contribution to the output from the nonlinear components of the system is obtained from the difference between the outputs of the two models.

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