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面射型雷射之多模動態現象

Vertical Cavity Surface-Emitting Laser (VCSEL) Multimode Dynamics

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摘要

低於 100 公尺的光通訊系統以多模光纖為傳遞介質，因此採用多模面射型雷射為光源。由於市場需求高於現有的 10Gb/s 頻寬，很多研究專注於加快雷射的速度。這些研究大致在探討雷射的小訊號頻率響應，而不正確的假設：雷射所有的模同步被激發。多模不同步的激發會產生不理想的波型、增加雜訊，因此降低通訊系統的頻寬。討論多模動態現象的文獻，大都以理論為主，用數值分析來模擬大量簡化過的物理公式。有與實驗比較的，也只局限於靜態的現象。本計劃將藉著實驗與理論，探討多模面射型雷射裏模間的動態作用，和它對雷射性能的影響。並由此所得的了解，設計一個新雷射，以應用於超過 10Gb/s 的光纖通訊系統。

Abstract

In the short-reach (<100 m) optical fiber communications, 850-nm multimode vertical-cavity surface-emitting lasers (VCSELs) are the work horse up to 10 Gb/s. Due to the demand for higher data rates, much effort has been put in the VCSEL design to increase the modulation speed. These works typically dealt with the small-signal frequency response with the implicit assumption that all the transverse modes are synchronously excited (which is not true). The asynchronous modal excitation can impair the large signal time waveform, increase the intensity noise, and thus limit the transmission data rate. The publications on the modal dynamics are mostly theoretical calculations using simplified device physics. Those with experimental results were concerned with DC operations. Thus we propose a comprehensive experimental and theoretical study of the multimode dynamics. This work should enhance the understanding of the modal dynamics and its impact on the laser performance. Based on the new insight, an improved VCSELs will be designed (and fabricated if a collaborating manufacturer can be found) for applications beyond 10 Gb/s.