



1. Ultrafast modulation of Cascade Semiconductor Lasers

Date Posted	9 March 2025	
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Project Description (200-300 words)	<p>Frequency combs (FC) are coherent light sources that emit a broad spectrum consisting of discrete, perfectly spaced modes, each having an absolute frequency measurable within the accuracy of an atomic clock. [1] After 20 years of development in the near-infrared and visible domains, FCs have revolutionized frequency metrology with strong impacts in other fields ranging from astronomy to communications [2]. However, FC operation in the crucial mid-wave infrared (MWIR) 3 μm to 5 μm region, nonetheless, remains considerably underdeveloped compared to other parts of the electromagnetic spectrum. The MWIR is critical as chemicals based on hydrocarbons as well as oxygen- or nitrogen-containing organic compounds have strong spectroscopic signatures [3], highlighting the MWIR importance in environmental and industrial emission control. Furthermore, this MWIR region in the most atmospheric transparent window in the entire MIR and therefore ideally adapted for free space optical communication (FSO). This MWIR region, however, is the sweet-spot operation for Interband Cascade Lasers (ICLs) [4,5]. These semiconductor sources combine the interband transition of a conventional diode laser with the voltage-efficient cascading scheme introduced by the quantum cascade laser (QCL) [6,7]. Importantly they typically have laser threshold powers that are an order of magnitude below QCLs making them ideal for extremely compact, stable and battery powered systems. Furthermore the relatively 'fast' gain dynamics of ICLs, compared to standard laser diodes, make them simultaneously adapted for both passive and active modelocking, facilitating the possibility of ultrafast modulation of ICL FCs. These three major points of i) emission in the range 3 – 5 μm, ii) low electrical power requirements and iii) inherent dynamics make them ideal for miniature MWIR FC operation.</p>	
Program/Center Website(s)	https://www.ens.psl.eu/ https://www.ntu.edu.sg/engineering	
Additional Information (e.g., files with project details)	Nil	