Optical feedback in cascade lasers: model, experiment and applications

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Over the past decade, the cascade lasers has established itself as one of the most promising radiation sources for sensing and imaging applications at terahertz and mid-infrared frequencies due to its ability to generate coherent continuous-wave emission with quantum noise-limited linewidths. This makes them particularly suited to the development of coherent sensing and imaging systems.

In this lecture, I will introduce laser-feedback interferometry utilizing the self-mixing phenomenon in cascade lasers. In this scheme a portion of the emitted beam is coupled back into the laser cavity after reflection from an external target. Optical retro-injection affects the laser's operating parameters; in particular, the laser emission frequency and the laser compliance voltage. By exploiting the interferometric nature of optical feedback, the laser effectively becomes a highly sensitive and compact homodyning transceiver.

I will present recent advancements in joint work between BM1205 COST Action's partners in School of Electronic and Electrical Engineering at the University of Leeds and School of Information Technologies and Electrical Engineering at the University of Queensland in modeling of the self-mixing effects and the its use in development of coherent imaging and sensing systems around terahertz Quantum Cascade Lasers (THz QCLs) and mid-infrared Interband Cascade Lasers (MIR ICLs). Examples will include different modalities of imaging, and in particular most recent tissue analysis of excised porcine and murine tissue.