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Next-generation communication and remote sensing capabilities unlocked by frequency-agile low-linewidth lasers

The efficient stabilization and linear modulation of the optical frequency is a key requirement in major sensing applications such as frequency-modulated continuous-wave (FMCW) LiDAR and distributed optical fiber sensing (DOFS), as well as in 5/6G telecommunication systems. There, the lasers performance requirement is twofold. In sensing systems, the resolution of the measurements is directly proportional to the inverse of the optical frequency chirp's bandwidth, leveraging the need for frequency-agile lasers. In any case, the noise floor is limited by the laser phase noise.
In this contribution, we present our most recent results regarding FMCW long-distance LiDAR [1], high-resolution distributed acoustic sensing [2] and optical phase-locked loop (OPLL) for low phase noise optically-carried RF signals and discuss the perspective brought by state-of-the-art integrated frequency-agile laser based on self-injection locking (SIL) [3]. In the scope of the FORTE European project, we present preliminary results on OPLL to stabilize the beatnote between two SIL lasers below -95 dBc/Hz below 10 kHz, as depicted in Figure 1. These results are in line with key performance factors identified for next-generation communication systems. As such, these outcomes coupled with TRT's progress on the systems architecture, integration and signal processing pave the way to provide technical answers to the recent stringent needs of the automotive, aeronautics, and defense industries.

References

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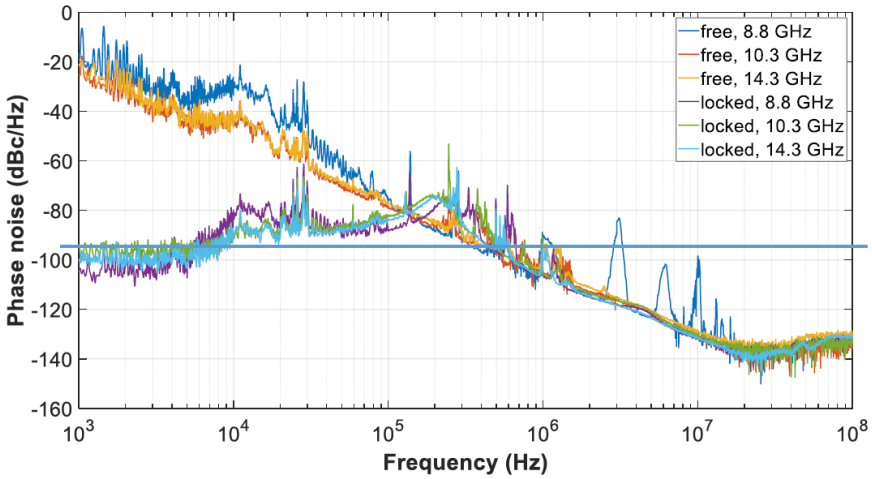

Figure 1 - Phase locked loop beatnote between two SIL lasers at various frequency offset in a locked and a free running state