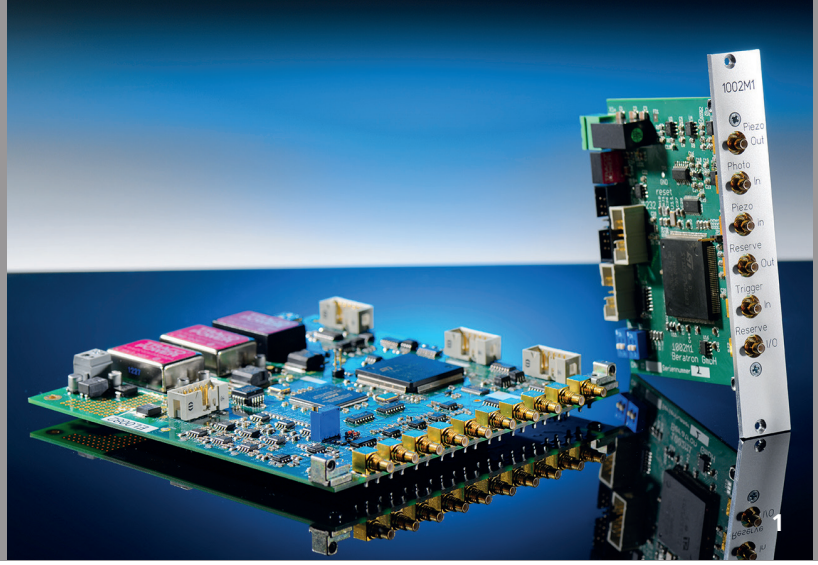

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CAVITY LENGTH CONTROL FOR FREQUENCY STABILIZATION OF LASER OSCILLATORS

Task

Detection of gases by LIDAR processes generally requires laser-beam sources which have high demands placed on their spectral characteristics. For airborne and satellite-based LIDAR instruments, pulsed oscillator-amplifier arrays (MOPA) are often used, which emit narrowband light pulses with high frequency stability. For this application, the oscillator in particular must be stabilized since it essentially determines the spectral characteristics of the MOPA. This is done by means of coupling it to a highly stable, narrowband seed laser, which requires resonator length control with accuracies lower than 100 nm. Vibration loads during flight operations pose a particular challenge.

Method

In cooperation with the company Beratron GmbH, Fraunhofer ILT developed electronic circuits for several control processes:

- Classic Ramp Fire.
- Spectral and temporal stabilization of two spatially superimposed MOPAs with fixed temporal pulse spacing using ramp fire.
- Ramp-Delay-Fire for time synchronization of the stabilized oscillator to an external signal.
- Cavity Dither for piezo-protective control of a satellite-based oscillator.

Depending on the environmental conditions and requirements, the institute has successfully employed the Pulse Build-Up Time process and the Pound-Drever-Hall process in other applications.

Results

Lasers stabilized with the Ramp-Fire process have been successfully used in aircraft and helicopter flight operations. The Ramp-Delay-Fire process has been implemented on a laboratory scale under experimentally simulated flight conditions, as has the Cavity-Dither process, and is ready for use. Depending on the requirements, the most suitable process or a combination of several processes is used.

Applications

Fraunhofer ILT achieved and implemented the results presented here in a large number of publicly funded projects as well as bilateral industrial projects. Examples of applications include the detection of leaks in pipelines, the measurement of wind speeds, and the detection of greenhouse gases and water vapor in the atmosphere.

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1 Electronics for the various control processes.

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