

Electronics and Communications Technologies

Laser to RF Phase Detector

with Femtosecond Precision

Technology

An electro-optical amplitude modulator is used in a special configuration to measure the relative phase between a pulsed laser and an RF signal with femtosecond precision. This laser to RF phase detector allows for precise control of either the laser phase or the phase of the RF signal in a phase-locked-loop and it works especially well at low RF frequencies like for example 1.3 GHz.

Benefits

The novel amplitude modulator based scheme is balanced, which means that in its operating point it is insensitive to common error sources like for example input power variations. It is easy to implement and allows for sub 10 femtosecond short-term and long-term synchronization accuracy and furthermore applicable to a wide range of laser repetition rates and RF frequencies.

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INNOVATION &
TECHNOLOGIE
TRANSFER —

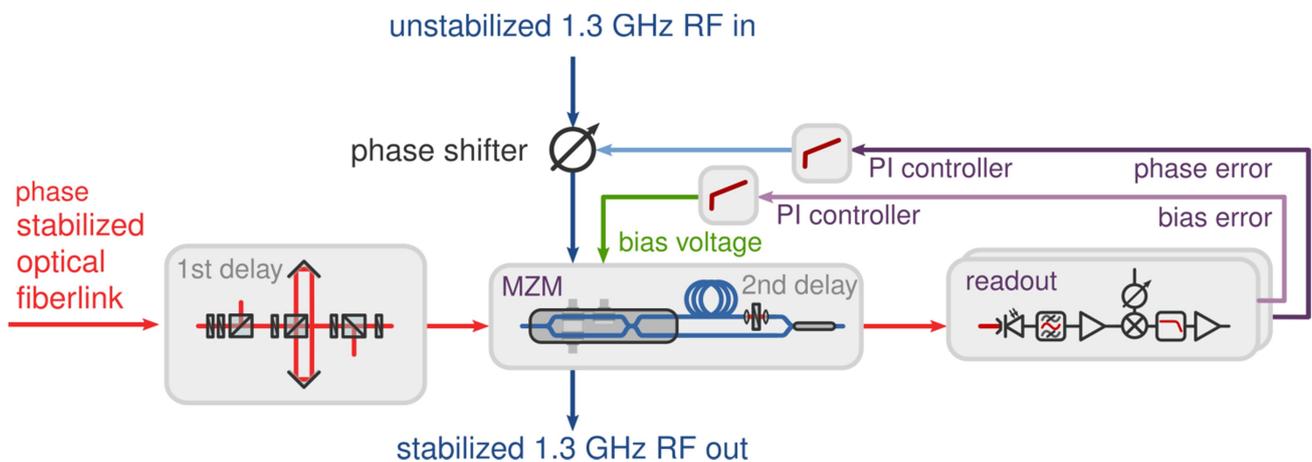


Challenge

Existing techniques to perform laser to RF phase detection either lack the required drift stability as for example direct conversion and digital or analog down-mixing or the implementation effort increases drastically at low RF frequencies such as 1.3 GHz. The latter is for example the case for Sagnac-Loop based phase detectors. A low-drift laser to RF phase detector with femtosecond precision which also works at 1.3 GHz was previously not available.

Innovation

The laser to RF phase detector exhibits low drift and low intrinsic jitter on a femtosecond level. The scheme has proven to deliver this performance not only in a well controlled laboratory environment but also under accelerator conditions. The scheme can be easily customized for different laser repetition rates and RF frequencies as required. The electro-optical amplitude modulator requires constant bias control in order to stay in its ideal operating point. The laser to RF phase detector allows to in situ measure and correct the current bias error.



Applications

- Synchronization of pulsed lasers to an RF reference
- Synchronization of RF oscillators to a pulsed laser
- Drift stabilization of RF signals with respect to a drift free optical reference

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