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Optical frequency reference

Timing accuracy is of the utmost importance for applications in science, technology and consumer applications such as navigation. Here we propose a method for the creation of low-cost timing references with exquisite precision based on mode-frequency differences that are stable against environmental fluctuations, locked using a sensitive mode.

BACKGROUND

The current state of the art in frequency references is based on measuring electronic transitions between atomic energy states. Devices based on this method are cumbersome and expensive. Consumer devices are therefore mostly based on quartz oscillators, with limited accuracy. It is therefore desirable to create a frequency reference which is highly precise, while at the same time presenting modest budget, power and space requirements.

TECHNOLOGY

A method is offered which enables the use of standard photonic and electronic systems to create high-precision timing references. The method relies on the stability in the difference between frequencies of certain optical modes against environmental fluctuations, such as changes in temperature. The comparison of the difference frequency with the frequency of a sensitive mode gives an additional error signal which can be used to further stabilize the reference. Such a set of modes exist, for example, in a Fabry-Pérot resonator, under particular selection of the resonator parameters.
It is furthermore possible to engineer such a set of modes in photonic integrated circuits. In this case, the integration of the resonator system with on-chip laser sources and electronics promises the realisation of an extremely compact, high-precision reference with moderate unit price.

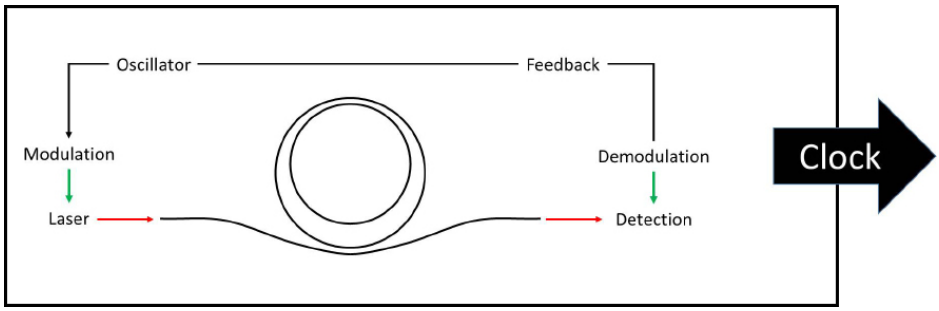

Fig 1: Mutliple light frequencies can be used to probe the relationships between resonance frequencies in an optical system. In an appropriately designed configuration, these frequency relationships can be exceedingly stable. Demodulation of the output signal can then generate a feedback signal to further stabilize the system, yielding a highly accurate, self-locking frequency reference.

ADVANTAGES

- Robust
- Low cost
- Purely optical
- Compatible with fiber networks

REFERENCE:
M001/2015

APPLICATIONS:
elecom (e.g. network synchronization)
Scientific
defense (guidance)
consumer (navigation)

DEVELOPMENT STATUS:
Concept

KEYWORDS:
- timing
- Frequency
- photonics

IPR:
Austrian Patent (AT 518 549) granted; PCT filed

OPTIONS:
- R&D - Cooperation
- License Agreement
- Patent sale

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