The concept of differential wavelength stabilization of the semiconductor lasers for time and frequency transfer system

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The precision of any bidirectional time and frequency transfer system depends, among other factors, on fluctuations of difference of lasers wavelengths[1] [2]. This paper describes the concept of differential wavelength stabilization of distributed feedback (DFB) semiconductor lasers. The idea of stabilization is presented in Fig1. The first laser located in the local module is stabilized using simple method based on temperature stabilization or on optical etalon. High absolute stability of the wavelength of this laser is not necessary, because essential is difference between lasers wavelengths. Optical signals from the local module and the second laser located in the remote module are supplied to a high-speed photodiode. Resulting beatnote with the frequency equal to the difference of the laser carriers is further processed by a high-speed prescaler. It divides the multi-GHz electrical signal to the value low enough for processing by a microcontroller. Prepared algorithm implemented in microcontroller creates the feedback signal for controlling wavelength of the second semiconductor laser in the way that the difference of lasers wavelengths is kept constant. Experimental evaluation of the concept shows relative stability of the wavelengths below 1 pm.

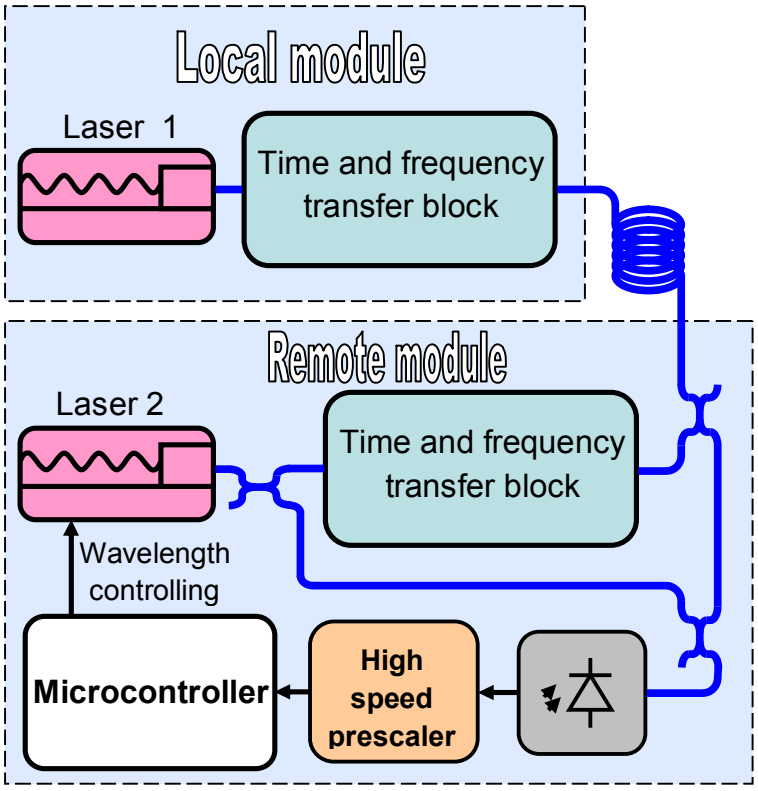

Fig. 1: Block diagram of differential wavelength stabilization of the semiconductor laser

[1] Ł. Śliwczyński, P. Krehlik, and M. Lipiński, "Optical fibers in time and frequency transfer", Meas. Sci. Technol. **21** (2010) 075302, 2012.

[2] Ł. Śliwczyński, P. Krehlik, A. Czubla, Ł. Buczek and M. Lipiński, " Dissemination of time and RF frequency via a stabilized fibre optic link over a distance of 420 km", Metrologia **50** 133–145, 2013.