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Instantaneous frequency measurement of microwave signals using a "frequency- amplitude" conversion in the fiber Bragg grating and the method of additive frequency offset

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Statement of Problem: Modern best structural solutions of microwave photonic systems for instantaneous frequency measurement (IFM) are based on “frequency-amplitude” measurement conversion using fiber Bragg gratings. The main disadvantage of microwave photonic systems for IFM with FBG is the monotonicity of the conversion characteristic in the area near the central wavelength of grating, which reduces the resolution of conversion at “low” radio frequencies (0.04 – 4 GHz).

Methodology & Theoretical Orientation: A new method for measuring the instantaneous frequency of the microwave signal, based on the transformation of the "frequency-amplitude" in the classical fiber Bragg grating with a Gaussian spectral outline is presented. Previously measuring frequency components of microwave signals are shifted additively in electrooptical Mach-Zehnder modulator at a frequency equal to half width of the grating spectral contour.

Findings: Using of these operations allows the instantaneous frequency measurements with high resolution and accuracy in the "low" frequency range. The proposed method is characterized by a simple realization and thermal stability as compared to methods using Bragg grating with special spectral contours: linear triangular and with a phase π-shift, which are used to remove small slope of "frequency-amplitude" transformation and the monotonicity of the grating spectral contour at this frequencies.

Conclusion & Significance: We described the principles of microwave photonic instantaneous frequency measurement system based on “frequency-amplitude” transformation in FBG. We identified possible way to improve their metrological characteristics in terms of available frequency range and resolution of low frequency identification by means of additional frequency shifting. Therefore, the low frequencies are measured on linear slope of FBG with good resolution and accuracy.

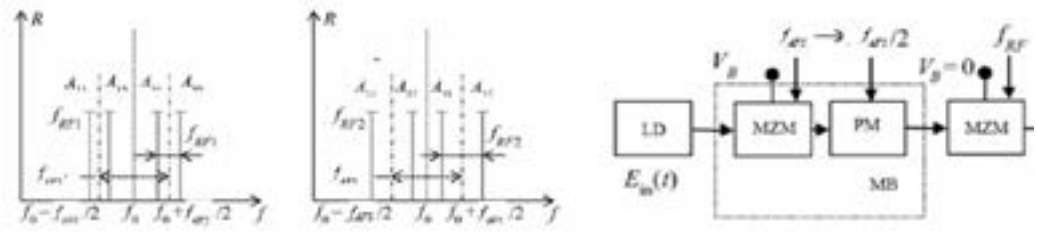

Fig. 5. IFM method with additional frequency separation: explanation of the operation principle (a), block diagram of the transmitting part (b)

Biography

Oleg G Morozov leads research on microwave photonics, fiber optic sensors and its interrogation. He has over 70 research papers and two books (in English) - concerning microwave photonics methods for fiber optic sensors interrogation. The current focus of his R&D institute is on novel smart multiplicative FBG sensors, optical frequency comb generation in wide range for PON sensor nets, design of spectrometer-interrogator for NIR range. The group enjoys strong international links, particularly with groups in India, Germany, Kazakhstan. He is a fellow of International Academy of Telecommunications, regular member of Optical Society n.a. Rojdestvenskiy (ROS), EOS, OSA, IEEE, and Senior Member of SPIE.

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