Kolobrodov V.G., Tymchyk G.S., Mykytenko V.I., Kolobrodov M.S. Physical and mathematical model of the digital coherent optical spectrum analyzer

A physical and mathematical model of digital coherent optical spectrum analyzers is discussed. In digital coherent optical spectrum analyzers the input signal is forming as a two-dimensional transparency by means of a spatial light modulator. After Fourier transformation with a lens, multiplication by a spatial filter and second Fourier transformation, the signal is captured by a matrix detector for further computer processing. A lot of digital coherent optical spectrum analyzers and their components (laser, lighting system, spatial light modulator, Fourier lens and matrix detector) models were developed to calculate the signal at the matrix detector output. They use the impulse response and transfer function to evaluate the effectiveness of digital coherent optical spectrum analyzers. The analysis of mathematical relationships shows that the use of a discrete spatial light modulator for the signal input and a matrix detector for light field registration in the spectral domain when combined with computer technology greatly extends the functionality of digital coherent optical spectrum analyzer. The formulas for impulse response and transfer function calculations were obtained, which allows to analyze and optimize the digital coherent optical spectrum analyzer basic characteristics.

Keywords: Matrix detector, Optical correlator, Optical spectrum analyzer, Spatial light modulator

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