A STUDY USING MATHEMATICAL MODELING THE DEPENDENCE OF THE LONGITUDINAL COHERENCE LENGTH OF WAVE FIELD FROM THE WIDTH OF ITS ANGULAR AND FREQUENCY SPECTRA

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A mathematical model of amplitude-phase fluctuations of partially coherent optical wave field of an extended source is proposed in the work. The researches of the spatial longitudinal correlation properties of a stochastic wave field with a wide angular spectrum based on a correlation analysis of the spatial lateral distribution of the complex amplitude of this field formed using numerical modeling are is carried out in the work. Using numerical modeling of field fluctuations the coherence functions of field fluctuations in the direction of its propagation and the lengths of longitudinal coherence at various levels of coherence degree have been determined. In graphical representations the dependence of the length of longitudinal coherence of the field from the width of its frequency spectrum and the width of the local angular spectrum have been obtained. A formula for calculating and estimating the length of longitudinal coherence in dependence from the known width of frequency and local angular spectra of the wave field with a given central wavelength has been proposed. Studies of the longitudinal correlation properties of stochastic wave fields with wide angular and frequency spectra based on computer modeling of spatial distributions of complex amplitudes of wave field realizations have shown their effectiveness and prospects for further development and using as an alternative or complement to a natural experiment and as visualization for understanding the processes of wave field formation.

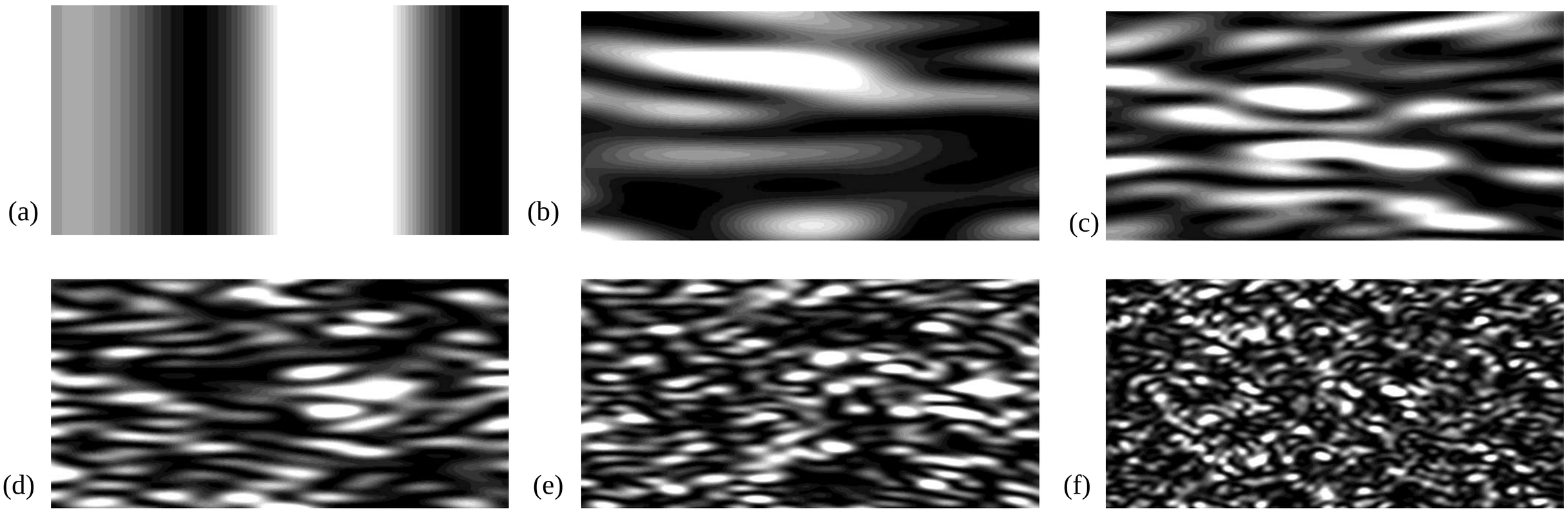

Fig. 1 Modeled speckle pattern in the longitudinal direction of the wave field with angular aperture NA_i:
a – 0; b – 0.2; c – 0.4; d– 0.6; e – 0.8; f – 1; λ_0 =0.55 μm; the width of the frequency spectrum $\Delta\lambda \approx 0.035$ μm;
the size of the fragments of speckle patterns 10x20 μm

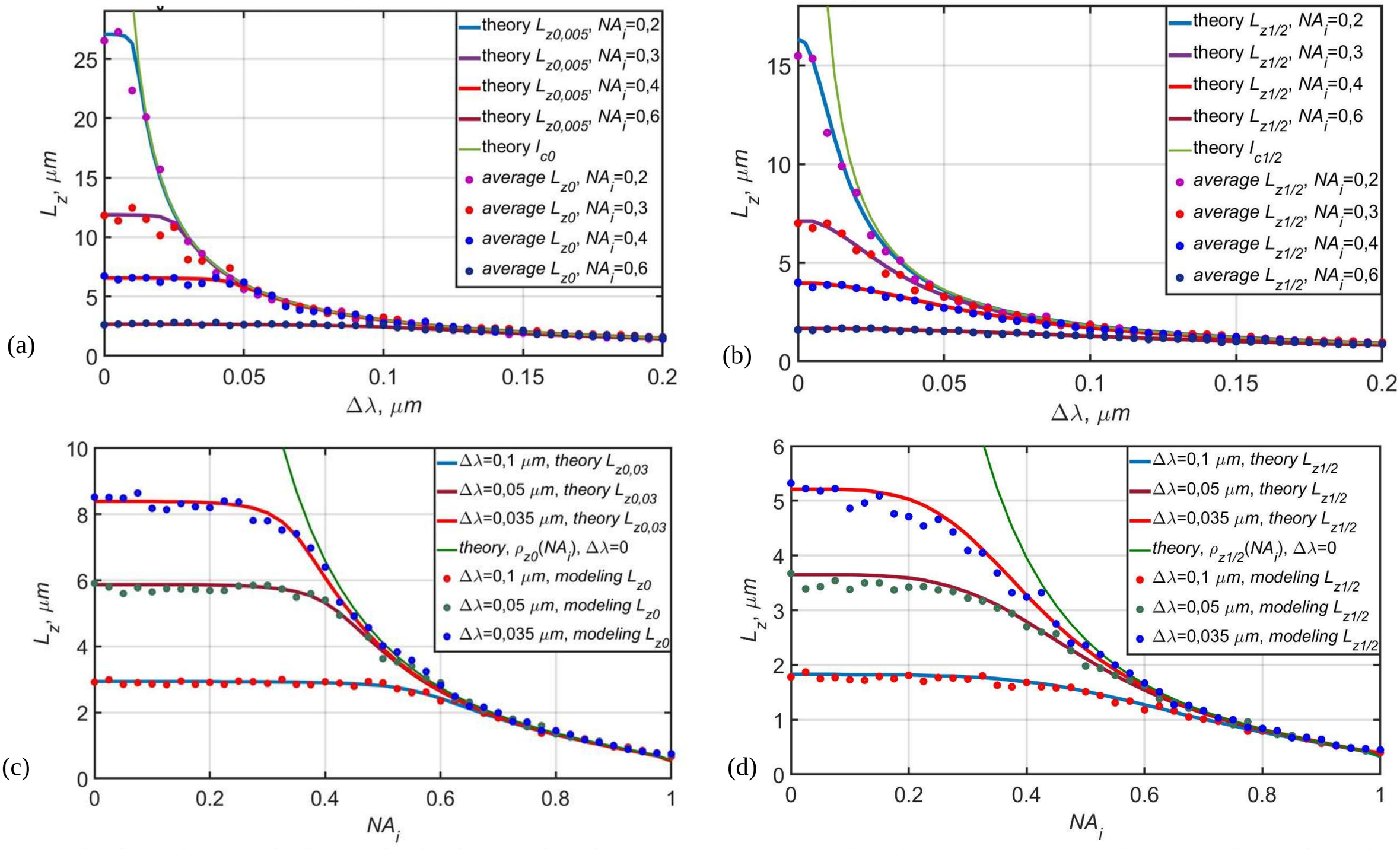

Fig. 2 The dependence of the longitudinal coherence length L_z from the width Δλ of the frequency spectrum of the wave field (a,b) with numerical apertures: NA=0.2, 0.3, 0.4, 0.6; end from the angular aperture NA_i (c,d) with the width of the frequency spectrum Δ λ≈0.035, 0.05, 0.1 μm, at a coherence level near 0 (a,c) and near 0.5 (b,d); λ_0 =0.55 μm;