LONGITUDINAL SPATIAL AND SPATIOTEMPORAL COHERENCE OF A LIGHT WAVE FIELD WITH WIDE ANGULAR AND FREQUENCY SPECTRA: MATHEMATICAL SIMULATION

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The coherent properties of a stochastic optical wave field in time and space in the direction of its propagation are investigated. Using the method of mathematical simulation of instantaneous random spatial functions of the complex amplitude of the wave field in its cross-sections, simultaneous and multi-temporal functions of the longitudinal coherence of the field were obtained. The longitudinal coherent properties of the field were investigated depending on the shape and width of the angular and frequency spectra of the field. The competing influence of the widths of the angular and frequency spectra of the field on the longitudinal coherence is shown. A comparison of the simulation results with the results of the formal theory of coherence was performed, which showed their coincidence with high accuracy. Studies of longitudinal correlation properties of stochastic wave fields based on computer simulation of spatial distributions of complex amplitudes of wave field realizations have shown their effectiveness and potential for use as an alternative or supplement to a natural experiment.

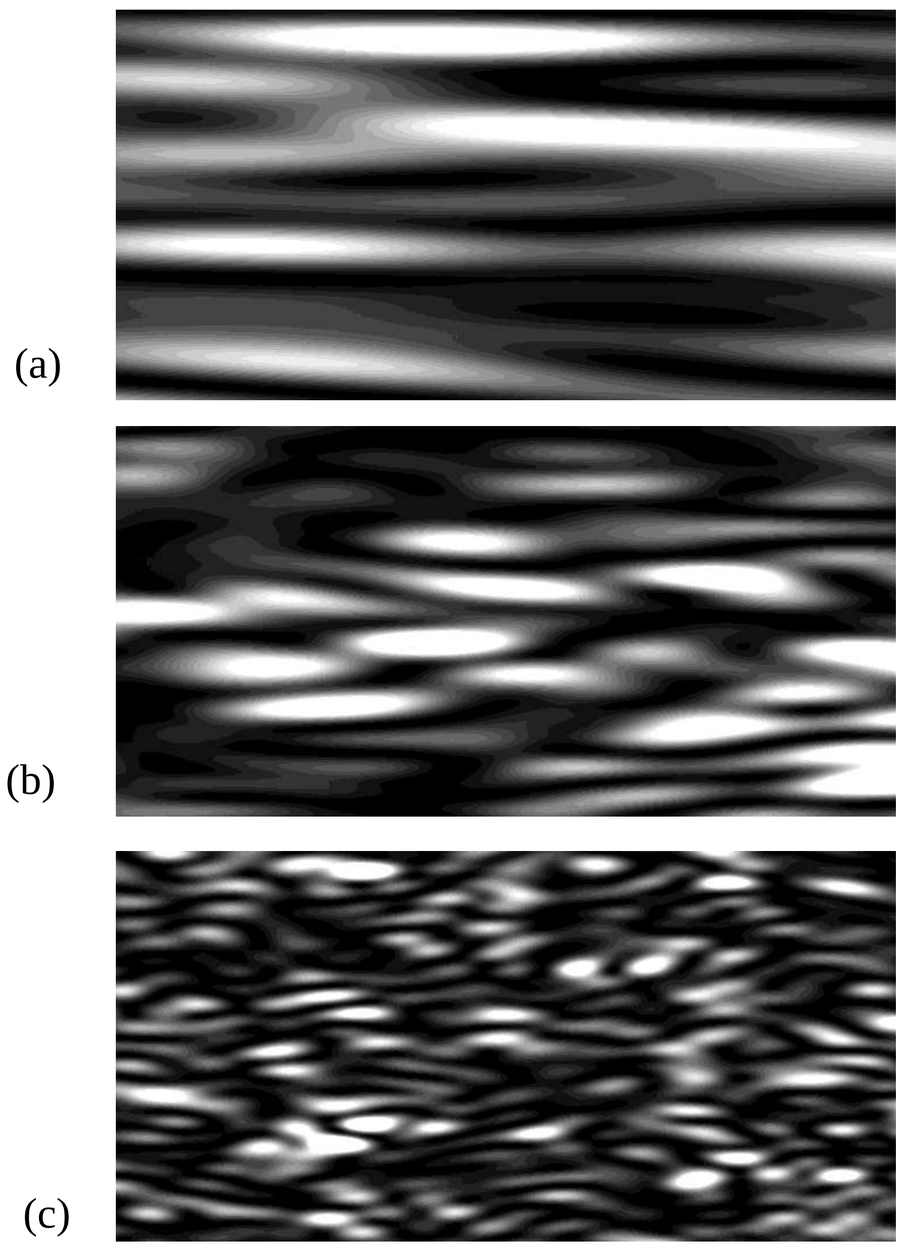

Fig. 1 Modeled speckle pattern in the longitudinal direction of the wave field with angular aperture NA_i: a – 0.3; b – 0.5; c – 0.8; λ_0 =0.55 μm; $\Delta\lambda\approx 0$; the size of the fragments of speckle patterns 10x20 μm

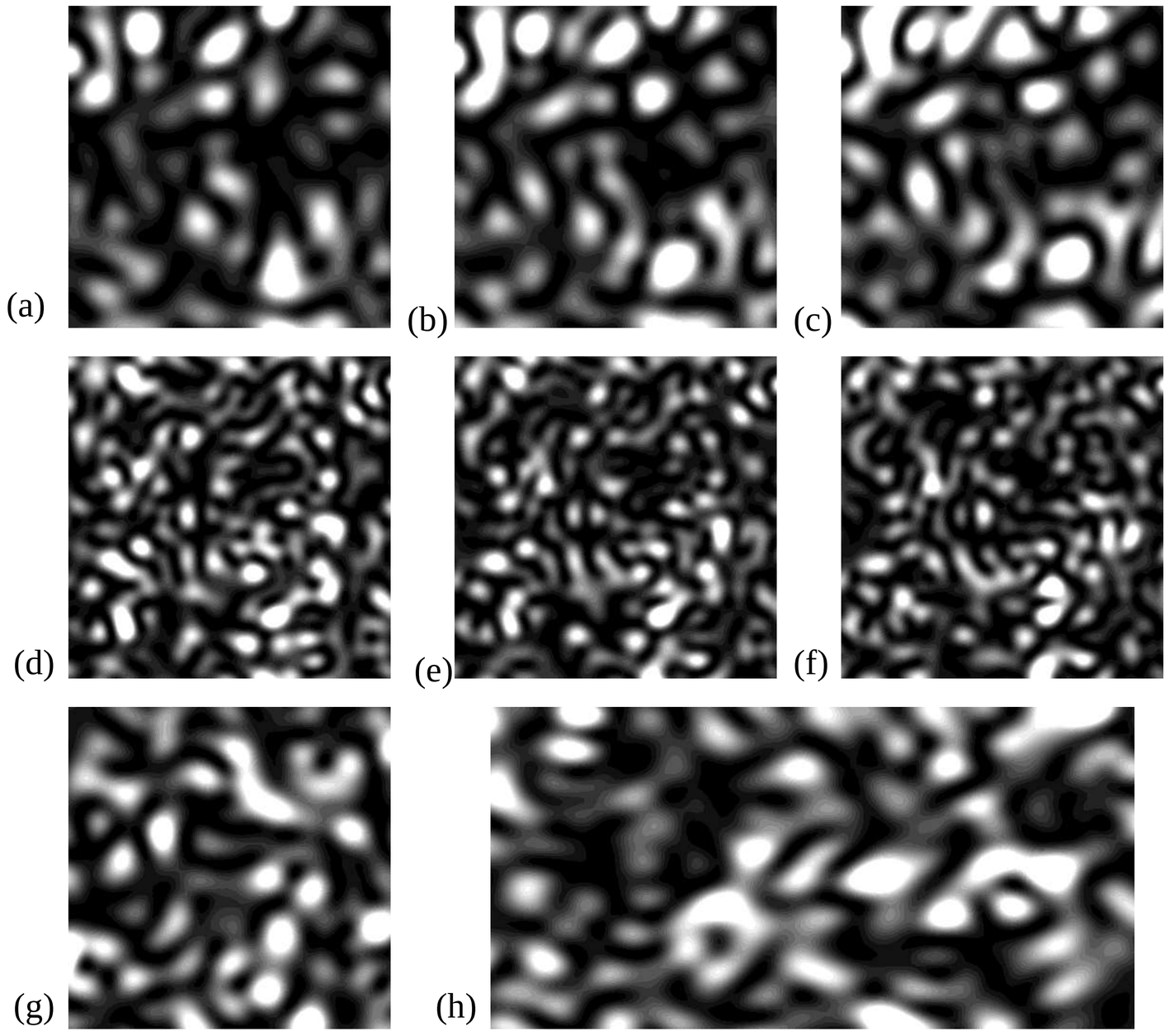

Fig. 2 Modeled speckle pattern of the wave field in the transverse section (a-g) and in the longitudinal direction (h) with angular aperture NA_i: a-c,g,h – 0.3; d-f – 0.5 at a distance of z in μm: a,d,g – 0; b – 3; c –6 with the width of the frequency spectrum $\Delta\lambda\approx$: a-f – 0; g, h – 0.2 μm; λ_0=0,55 μm; the size of the fragments speckle patterns 10x10 μm (a-g), 10x20 μm (h)

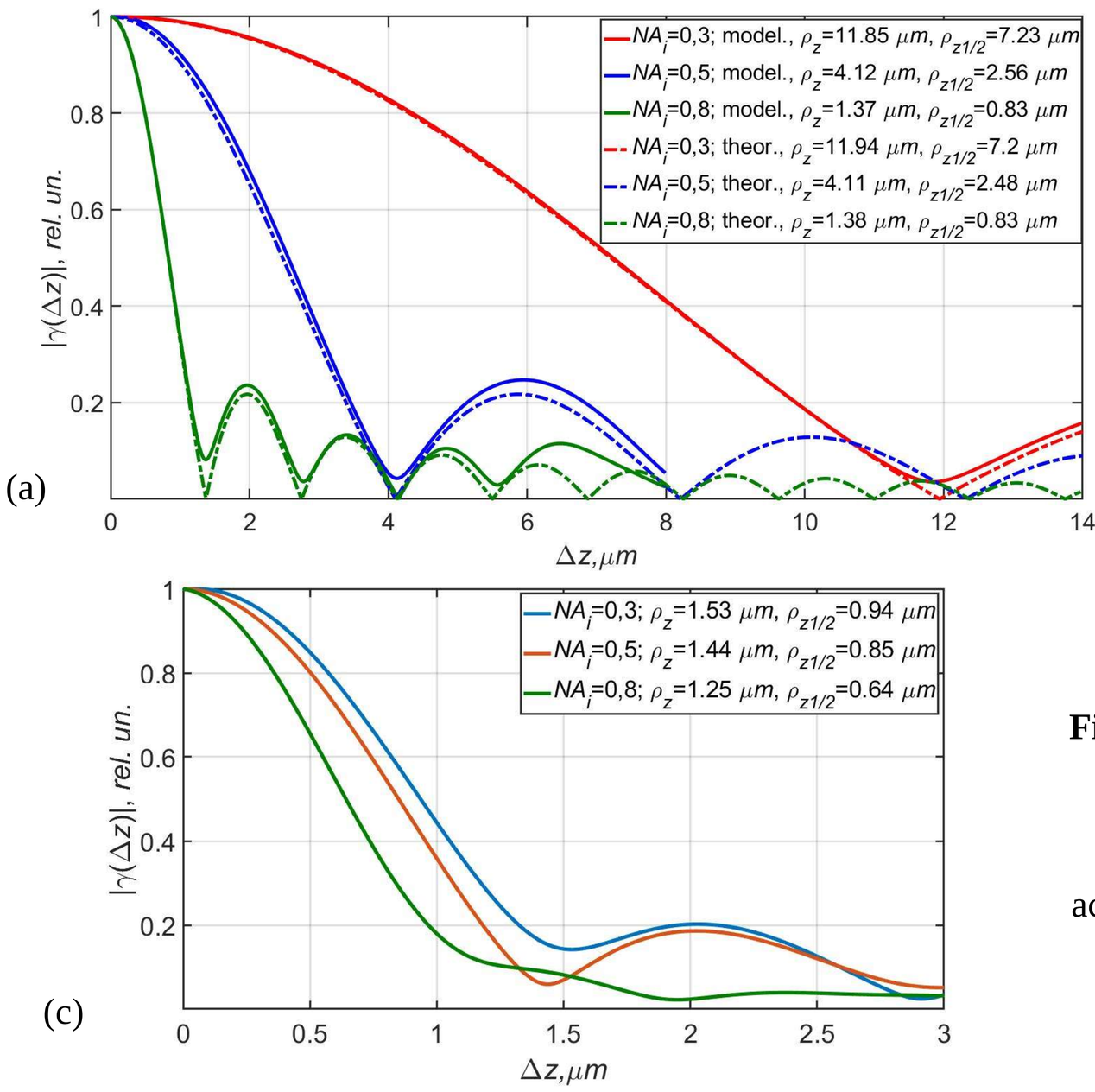

Fig. 3 Correlation function of the complex amplitude of the wave field using the averaging procedure over an ensemble of simulated realizations of the stochastic structure of the wave field in the longitudinal direction with angular aperture NA_i (a,b,c), according to various realization of the field with aperture NA_i=0.5 (b); the width of the frequency spectrum $\Delta\lambda\approx$: a,b – 0; c – 0.2 μm; λ_0 =0.55 μm;