Investigation of the transverse-mode composition of dispersionless multimode beams using correlation filters

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Abstract

The modes of laser radiation are the beams with the amplitude-phase distributions in their cross-section described by the eigenfunctions of the operator of light propagation in a guiding medium. The two-dimensional nature of the cross-section of real waveguides is consistent with the existence of beams with the amplitude-phase distribution in their cross-section described by the superposition of several modes with the same value of the propagation constant. Such beams have previously been called "dispersionless" [1] because of their ability to propagate with zero intermode dispersion, similar to individual modes. Such a beam propagates in a waveguide without the pulse broadening caused by intermode dispersion. Such beams can have interesting practical applications, for example, in the construction of highly efficient optical communication lines. We should note that the beams of this type, similar to individual modes, retain their amplitude-phase structure when propagating in a medium. The arbitrariness in the choice of the coefficients for different modes in the beam provides an additional degree of freedom when developing an iterative procedure for the design of diffractive optical elements - the formers of such beams. This article contains the results of a field study of dispersionless beams formed by diffractive optical elements, in particular, the results of measuring the transverse-mode composition of dispersionless beams using special mode correlation filters, implemented as amplitude holograms.

Keywords: transverse-mode, mode of laser radiation, dispersionless multimode beam, correlation filter, zero intermode dispersion, diffractive optical element, amplitude hologram.

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Access full text (in Russian)

References

[1] Pavelyev VS, Soifer VA. Selection of laser radiation modes [In Russian]. In Book: Soifer VA, ed. Methods of computer optics. Ch 6. Moscow: "Fizmatlit" Publisher; 2000: 395-469.
[2] Yariv A. Quantum electronics. 2nd ed. New York: John Wiley and Sons Inc; 1975.
[3] Soifer VA, Golub MA. Laser beam mode selection by computer generated holograms. Boca Raton, FL: CRC Press; 1994.
[4] Duparré MR, Pavelyev VS, Luedge B, Kley E-B, Soifer VA, Kowarschik RM. Generation, superposition, and separation of Gauss-Hermite modes by means of DOEs. Proc SPIE 1998; 3291: 104-114.
[5] Kotlyar VV, Soifer VA, Khonina SN. Light beams with periodic properties [In Russian]. In Book: Soifer VA, ed. Methods of computer optics. Ch 7. Moscow: "Fizmatlit" Publisher; 2000: 470-541.
[6] Fienup JR. Phase retrieval algorithms: a comparison. Appl Opt 1982; 21(15): 2758-2769.