TOLERANCE ANALYSIS OF COHERENT COMBINING OPTICAL SYSTEM

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The aim of work was the development of semi-analytical model for evaluation of coherent combining optical systems. The 2D arrays of laser beams ordered in rectangular or hexagonal lattice architecture were analyzed. The geometry of the incident array i.e. number of emitters, structure of the array and the beam profile of the emitter were taken into account. The far field intensity distributions were calculated based on partial coherent summation of individual Fourier images. To define measures of combining efficiency, Strehl Ratio and Power In Bucket (PIB) distribution were calculated for each case. In such a way we can determine maximal intensity and power content in main diffraction lobe, the horizontal-PIB to define beam diameter at certain level (e.g. 86.5% PIB) and power content for a given beam diameter (vertical-PIB). The more dense hexagonal geometry has shown the advantages over rectangular one, mainly because of better filling factor. The two opposite cases (fully coherent combing vs incoherent combining) were analyzed in the first steps. It was found that taking the criterion of 86.5% of PIB we obtained the same beam diameter in both cases for rectangular geometry which was the most surprising result. In a case of hexagonal geometry the 60% bigger beam area in far field was obtained for the incoherent combining w.r.t coherent combining for '*top-hat*' beam evidencing the important role of the beam profile. Moreover, such approach enables us to investigate the effects of the individual tilts and phase on the effectiveness of the combining. These low-order aberrations causes two phenomena in the far-field irradiance pattern: energy leak into the side lobes and distortion of the main lobe. We investigated how these aberrations effects on combining efficiency , Strehl Ratio and PIB.