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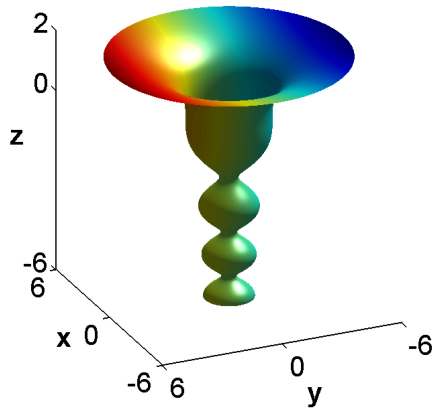

Fig. 1: Half-width of the fundamental mode.

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Mathematical and numerical analysis of the spectral characteristics of dielectric microcavities with active regions

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We study electromagnetic fields and emission thresholds of two-dimensional dielectric microcavities solving the lasing eigenvalue problem (LEP) proposed in [1]. We solve the LEP for microcavities of arbitrary shape with active regions. Namely, we propose a new convenient formulation of the LEP as a nonlinear spectral problem for a Fredholm holomorphic operator-valued function, which includes weakly singular integral operators. On the base of the new formulation of the problem we investigate the qualitative properties of the characteristic set: the localization on the corresponding Riemann surface, the discreteness, the dependence of the characteristic values (eigenfrequencies) on the threshold gain and nonspectral parameters.

We reduce the original problem to the system of Muller boundary integral equations, which we solve numerically by the Nystrom method [2]. We prove a theorem on convergence of the Nystrom method. We get the following results. If there exists a solution to the set problem, then there exists a sequence of eigenvalues of the Nystrom method matrix, converging to the exact solution as a number of grid points increases. On the other hand, if there exists a converging sequence of the above mentioned eigenvalues, then it converges to the exact problem solution.

We propose a new computer implementation of the Nystrom method and calculate the spectral characteristics of new types of microcavities with active regions, having the following important for applications properties: the low thresholds of lasing and the sparseness of spectrum.

References

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