

# Path optimization in inhomogeneous media by a direct approach

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A variant of the direct optimization method for point-to-point ray path is presented. The main features of this approach are stability in the case of a large divergence of the rays and locality - only rays connecting the start and end points are calculated. These circumstances make it possible to most effectively apply analytic-numerical formulas for the wave amplitude based on the Maslov operator. The main idea of the proposed variational approach is to successively optimize the ray path from some initial approximation to the desired optimum — the solution for which the objective function satisfies the stationarity principle. The presented method has the ability to determine both minima and saddle points of a given functional. A procedure for a systematic search for a set of stationary solutions based on the transitional properties of saddle points is implemented. In the framework of this work, the method is applied to calculate optimal paths in various fields [BT24, BK78], including tunneling effects and tsunami problem. Verification was carried out with the results of traditional ray tracing.

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- [BK78] S. Bolotin and V. Kozlov, *Libration in systems with many degrees of freedom*, J. Appl. Maths. Mechs. **42** (1978), pp. 256–261.
- [BT24] S. Bolotin and D. Treschev, *Another billiard problem*, Russ. J. Math. Phys. **31** (2024), pp. 50–59.