BOUNDARY-CONFORMING CURVILINEAR COORDINATES WITH GRID CURVES CONTROL APPLIED TO SCATTERING FROM ARBITRARY SHAPE OBSTACLES

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A new algorithm to generate two-dimensional boundary conforming coordinates, with grid curves control, over multiple connected regions $\mathcal{D}$, is devised. The algorithm is based on the numerical solution of a Dirichlet boundary value problem over a rectangular computational domain $\mathcal{D}'$ obtained as the image of the physical domain $\mathcal{D}$. The boundary value problem is governed by a popular quasilinear elliptic system of equations used for automatic grid generation with source terms P and Q. These source terms are systematically defined over the computational domain $\mathcal{D}'$. Grid curves control over the multiple connected regions with one or more holes in its interior is established by appropriately distributing grid points over the branch cut, which is used to transform the non-connected physical domain $\mathcal{D}$ into a connected rectangular computational domain $\mathcal{D}'$. By specifying the coordinates of the grid points over the branch cut, as part of a Dirichlet boundary condition, and by defining the source terms P and Q appropriately, we are able to generate a grid whose coordinate curves follow the distance pattern of their corresponding grid points over the branch cut. However, the resulting grid is non-smooth over the branch cut. To solve this problem, an iterative smoothing procedure is applied to the previous grid to generate a new grid that is both smooth and has grid lines concentration according to the grid points distribution over the branch cut. A time-dependent numerical method described in [1] is applied over grids generated according to the above procedure, to obtain time harmonic steady-state solutions to scattering of a plane acoustic wave from arbitrary shape obstacles. The algorithm is tested over irregular domains as the three-leafed rose and a three-punctured regions.

References

[1] V. Villamizar, O. Rojas "Time-Dependent Numerical Method with Boundary-Conforming Curvilinear Coordinates Applied to Wave Interactions with Prototypical Antennas," *J. Comput. Phys*, v. 177, p. 1-36, 2002.