The collocation Trefftz method for acoustic scattering by multiple elliptical cylinders

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In this paper, the collocation Trefftz method is presented to solve the problem of the acoustic scattering of a plane sound wave by multiple elliptical cylinders. To satisfy the Helmholtz equation in the elliptical coordinate system, the scattered field is formulated in terms of angular and radial Mathieu functions. The boundary conditions are satisfied by uniformly collocating points on the boundaries. The acoustic pressure at each boundary point is directly calculated in each elliptical coordinate system. In different coordinate systems, the normal derivative of the acoustic pressure is calculated by using the appropriate directional derivative, an alternative to the addition theorem. By truncating the multipole expansion, a finite linear algebraic system is derived and then the scattered field can be determined according to the given incident acoustic wave. Once the total field is calculated as the sum of the incident field and the scattered field, the near field acoustic pressure along scatterers and the far field scattering pattern can be determined. The proposed results of scattered fields by two, three and four elliptical-cylindrical scatterers are compared with those of available analytical solutions and the BEM to verify the validity of the present method. Finally, the effects of the space among scatterers and the incident wave number and angle on the scattered fields are investigated in this paper.

Keywords: Collocation Trefftz method, Acoustic scattering, Helmholtz equation, Mathieu functions, Elliptical cylinder, Far field scattering pattern.