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FINITE ELEMENT METHOD FOR STRUCTURAL-ACOUSTIC COUPLING PROBLEM WITH FICTITIOUS DOMAIN METHOD

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We consider the numerical treatment of structural-acoustic coupling vibration problem between a closed shell and two acoustic regions: one is an inner region bounded by the shell, and the other is an unbounded outer acoustic region. The problem exhibits a formulation of the domain decomposition method with a generalized Lagrangian multiplier. The Lagrangian multiplier is the normal deformation of the shell, which is coupled with the tangential deformation and acoustics pressures of the two regions. The problem is approximated by the finite element method, in which the fictitious domain method with a locally fitted mesh is applied to discretize the inner and outer acoustic regions and to construct the preconditioners for the Krylov subspace iteration to solve the resulting block matrix equation.

When a polar mesh is used for the inner bounded acoustic region, one faces an artificial singularity at the origin. Therefore, Nasir and Kako (*Theor. and App. Mech.*, **50**, 2001, 391 - 401) used a rectangular mesh for the interior region and a polar mesh for the exterior region. When the locally fitted mesh technique is applied, it gives non-matching nodes at the boundary of the shell. Hence, they had to use a linear transformation to compute the pressures at the shell boundary to transform from the rectangular mesh to the polar mesh and *vise versa*. This gives an additional computational cost.

In this study, a polar mesh is used for both interior and exterior regions to avoid the non-matching nodes. To avoid the artificial singularity, we use an inner artificial boundary that excludes the origin from the computational domain and impose an artificial boundary condition on this boundary. The pressures in the discarded region can also be computed by using an analytical expression with the mixed type method.

We show numerically that the new approach is computationally efficient in terms of memory requirement and computational time. Accuracy of the solution is then improved by considering a more refined finite element mesh with less computational cost.

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