Lagrange-Multiplier-Based Partitioned Method for Ocean-Atmosphere Coupling

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ABSTRACT

Complex multiphysics applications often require the efficient and stable coupling of individual codes or separately meshed regions through non-matching interfaces. A characteristic example of this type of coupling occurs between atmospheric and ocean codes in global Earth system models. The coupling conditions in the ocean-atmosphere context typically require continuity of surface stress and heat flux, which are defined by a parameterization of the surface layer that depends on the jump in state (velocity or temperature). In Earth system modeling it is crucial that fluxes are conserved across non-matching meshes from independent ocean and atmosphere numerical discretizations and that the coupling algorithm is stable over long integration times.

In this talk we introduce an explicit Lagrange multiplier-based interface coupling method that is accurate and stable when applied to advection-diffusion equations with coupling conditions analogous to a simplified ocean-atmosphere system. This method is an extension of a recently developed coupling scheme for systems of equations that require continuity of state and flux at the interface [1]. The scheme is derived from a well-posed monolithic formulation of the problem and defines an expression for the Lagrange multiplier along the interface. This Lagrange muliplier may be computed directly and used for boundary data in partitioned solves on each domain. Numerical results for finite element discretizations of advection-diffusion equations coupled along a non-matching interface demonstrate the stability of the formulation and second-order convergence.

REFERENCES

[1] Peterson, K., P. Bochev, P. Kuberry, Explicit synchronous partitioned algorithms for interface problems based on Lagrange multipliers, *CAMWA*, doi:10.1016/j.camwa.2018.09.045 (2018).

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