

## The Schwarz alternating method for ROM-FOM coupling

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**Key Words:** Schwarz alternating method, domain decomposition, projection-based reduced order model (ROM), heterogeneous coupling

Although projection-based model order reduction is a promising approach for enabling real-time and multi-query analyses, reduced order models (ROMs) have been known suffer from a lack of robustness, stability and accuracy, especially in the predictive regime. This talk describes a new methodology for improving the predictivity of projection-based ROMs by coupling these models conventional full order models (FOMs) using the Schwarz alternating method. The Schwarz alternating method [1] is based on the simple idea that if the solution to a partial differential equation (PDE) is known in two or more regularly-shaped domains comprising a more complex domain, these local solutions can be used to iteratively build a solution on the more complex domain. Leveraging recent work that adapted the Schwarz alternating method to enable consistent and concurrent multi-scale coupling of finite element FOMs in solid mechanics [2, 3], we present a new extension of the Schwarz formulation that enables ROM-FOM coupling. The new approach is based on the following ingredients: (i) a decomposition of the physical domain of interest into two or more overlapping subdomains, (ii) the construction of either a FOM or a projection-based ROM in each of the subdomains, (iii) the definition of appropriate transmission boundary conditions (BCs) which will propagate information between the overlapping subdomains, and (iv) the introduction of a Schwarz iteration process in which the ROM and FOM solutions on each subdomain are successively updated (to convergence) in an iterative and alternating fashion, with information between subdomains propagating through the transmission BCs. After describing the method's formulation and theoretical properties, we evaluate its performance on several numerical examples from the field of solid mechanics. Specifically, we demonstrate that the method is capable of producing a more accurate solution than the classical single-domain Proper Orthogonal Decomposition (POD)/Galerkin ROM approach, while still achieving a computational savings with respect to a typical FOM discretization.

### REFERENCES

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