Towards adaptive hybrid models via domain decomposition

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This talk will detail the development of a new approach for creating adaptive hybrid models through domain decomposition. This approach involves several key ingredients: (i) decomposition of the spatial domain into subdomains based on carefully-developed criteria, (ii) independent meshing/discretization of each subdomain, and (iii) seamless coupling of subdomains using the Schwarz alternating method (SAM). After overviewing SAM as a means to achieve concurrent multi-scale coupling, I will describe a recent extension of SAM that enables the gluing together of arbitrary combinations of subdomain-local high-fidelity models (HFMs) with subdomain-local reduced order models (ROMs). I will focus attention on two types of reduced order models: intrusive projection-based ROMs constructed via the Proper Orthogonal Decomposition (POD)/Least Squares Petrov Galerkin (LSPG) method, and non-intrusive ROMs constructed via Operator Inference (OpInf). I will end the talk by describing some recent work aimed to develop and assess rational, automated and efficient criteria to identify where/when less refined or reduced-order models can be used without compromising accuracy, towards enabling on-the-fly switching between subdomain-local models of varying fidelities.