Title: Reduced-order models for compressible flows: space-dependent aggregation models

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Abstract: In this work we combine non-intrusive reduced order models (ROMs) with space-dependent aggregation techniques to build a mixed-ROM, able to accurately capture the flow dynamics in different physical settings. The flow prediction obtained using the mixed formulation is derived from a convex combination of the predictions of several previously trained Reduced Order Models (ROMs), with each model assigned a space-dependent weight. The ROMs incorporated in the mixed model utilize different reduction methods, such as Proper Orthogonal Decomposition (POD) and AutoEncoders (AE), and various approximation techniques, including Radial Basis Function Interpolation (RBF), Gaussian Process Regression (GPR), and feed-forward Artificial Neural Networks (ANN). Each model's contribution is given higher weights in regions where it performs best and lower weights where its accuracy is lower compared to the other models. Addi- tionally, a Random Forest regression technique is used to determine the weights for previously unseen conditions.

The performance of the aggregated model is assessed through two test cases: the 2D flow past a NACA 4412 airfoil at a 5-degree angle of attack, with the Reynolds number ranging between 1.0 × 105 and 1.0 × 106, and a transonic flow over a NACA 0012 airfoil, with the angle of attack as the varying parameter. In both scenarios, the mixed-ROM demonstrated improved accuracy compared to each individual ROM technique.