Reduced Basis Approximation of Coupled Problems

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The coupling of two variational problems has many farreaching applications in several fields, such as fluid flow through porous media [1] or chemical reactions in a catalyst or a fuel cell. We study a coupled (time-dependent) convection-dominated problem on a domain Ω_1 and a diffusion-reaction problem on a domain Ω_2, whereby Ω_1, Ω_2 are only connected through an interface. On this interface, the interchange and interference between these two processes is modeled and therefore meaningful boundary conditions have to be established. Different inflow conditions and reaction coefficients serve as parameters.

Firstly, we can deduce a saddle-point formulation. However, existence and uniqueness of a solution is not straightforward to prove. To overcome this issue, we will present an alternative approach partly following [2]. Additionally, we apply the Reduced Basis Method on our coupled problem aiming a reduction of computational time. To achieve this goal, we use an offline/online-decomposition and efficient bounds for the arising error. Our approach is a space-time variational formulation of the coupled problem and we utilize amongst others the error estimator developed in [3]. In this context, we want to discuss the difficulties originating from the interferences on the coupling boundary. We particularly consider the effect on the numerical determination of accurate bounds for the inf-sup and continuity constants, which are crucial for the fast computation of efficient error estimators.

References

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