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Hybrid thread-MPI parallelization for ADR equation

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1 Problem statement

1.1 Strong formulation

Consider the following **Advection-Diffusion-Reaction** equation:

$$\begin{cases} -\nabla \cdot (\mu \nabla u) + \nabla \cdot (\beta u) + \gamma u = f & \text{in } \Omega, \\ u = g & \text{on } \Gamma_D \subset \partial\Omega, \\ \nabla u \cdot n = h & \text{on } \Gamma_N = \partial\Omega \setminus \Gamma_D. \end{cases}$$

1.2 Weak formulation

First of all, we define the following function spaces:

$$V = H^1(\Omega) = \{v \in L^2(\Omega) : \nabla v \in (L^2(\Omega))^d\},$$

$$V_g = \{v \in H^1(\Omega) : v = g \text{ on } \Gamma_D\},$$

$$V_0 = \{v \in H^1(\Omega) : v = 0 \text{ on } \Gamma_D\}.$$