A Posteriori Error Bounds for Finite Element Approximations of Mean Field Games

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Abstract

A posteriori analysis is a powerful tool in the finite element method (FEM) approximation of partial differential equations (PDE). The analysis provides computable error estimators which can be used to reliably evaluate the accuracy of a numerical approximation without prior knowledge of the underlying analytical solution.

In this talk we present recent works on the a posteriori analysis of stabilised FEM approximations to mean field games (MFG). A posteriori analysis for MFG presents several interesting challenges due to the lack of coercivity of the MFG system, the nonlinear coupling terms, the requirement of a discrete maximum principle, and the loss of Galerkin orthogonality due to stabilisation. To overcome this we prove an equivalence result between approximation error and the dual norm of the corresponding PDE residuals of the MFG system. Then we derive computable error estimators and we prove their reliability and efficiency with respect to the error between exact and numerical solutions.