Modeling and Computation of Transboundary Industrial Pollution by Differential Games

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Abstract

The term “transboundary pollution” means that the pollution generates in one region and influence the neighboring regions’ environment through water or air and so on, which requires international actions to control its formation and effects. In this talk, we present a stochastic differential game to model the transboundary industrial pollution with emission permits trading. More generally, the emission permit price is endogenous, and it is assumed to follow a geometric Brownian motion (GBM). We make use of stochastic optimal control theory to derive a system of Hamilton-Jacobi-Bellman (HJB) equations satisfied by the value functions for cooperative and noncooperative games, respectively, and then propose a so-called fitted finite volume method to solve it. The efficiency and usefulness of this method are illustrated by the numerical experiments. The two regions’ cooperative and noncooperative optimal emission paths, which maximize the regions’ discounted stream of net revenue, together with the value functions, are obtained. Additionally, we can also obtain the threshold condition for the two regions to decide whether they cooperate or not. Some sensitivity analysis has also been made to examine the effects of parameters on the results.

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