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## A GAME THEORY APPROACH FOR THE OPTIMAL CONTROL OF GROUNDWATER POLLUTION

**Abstract.** The purpose of this talk is the study of a spatial differential game in the case of non cooperative result of groundwater pollution.

We consider two polluters with different spread policies and define two economic objectives taking into account the private benefits of the polluter and the environmental damage due to the pollution. These spatio-temporal objectives are constrained by the hydrogeological state equations : the spreads of the pollutant in the underground and the velocity of the flow, respectively modeled by a convection-diffusion-reaction equation and an elliptic PDE.

By using a fixed point strategy, we prove the existence result of a Nash equilibrium. The main difficulty for proving the uniqueness is due to the non linearities. We use the Pontryagin's approach in order to derive the corresponding optimality conditions. According to some additional assumptions on the objective functions, we prove the uniqueness of the Nash equilibrium ([4]). Using benefit function from Godart et al. [1], we conclude with some numerical simulations.

## RÉFÉRENCES

- [1] C. GODART, P. A. JAYET, B. NIANG, L. BAMIÈRE, S. DE CARA, E. DEBOVE, E. BARANGER. RAPPORT FINAL, APR GICC 2002, CONVENTION DE RECHERCHE MEDD NUM 02-00019, UMR ECONOMIE PUBLIQUE INRAE-INAPG, 2002.
- [2] E. AUGERAUD-VÉRON, C. CHOQUET, É. COMTE, Optimal control for a Groundwater Pollution Ruled by a Convection-Diffusion-Reaction Problem. *Journal of Optimization Theory and Applications*, 173(3), 941-966, 2017.
- [3] E. AUGERAUD-VÉRON, C. CHOQUET AND É. COMTE, Existence, uniqueness and asymptotic analysis of optimal control problems for a groundwater pollution. *ESAIM : Control, Optimization and Calculus of Variations*, 25, Article number 53, 2019.
- [4] E. AUGERAUD-VÉRON, C. CHOQUET, É. COMTE AND M. M. DIÉDHIU, A game theory approach for the groundwater pollution control (**under revision**).