Atelier
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Control theory and viability methods for the sustainable management of natural resources

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We cover applications of control theory and optimization to the management of natural resources. To begin with, we present some stylized decision models in climate change mitigation, fisheries management, epidemiology. We show how a priori conflicting objectives such as economic (production) versus ecological (preservation) can be formulated as constraints to be satisfied by a control dynamical system. Viability analysis provides conditions under which there exist management strategies which allow these constraints to be satisfied, on a given horizon. As an application, we present a viability analysis of the anchovy–hake couple in the Peruvian upwelling ecosystem. We also develop a notion of ecosystem sustainable yields. When uncertainties affect the dynamics, we show how to adapt the above framework and we introduce robust and stochastic viability. In the latter case, we propose to rank strategies by their probability to achieve given objectives for all times on a given horizon. A numerical application to the management of a dam for electricity production under a "tourism" constraint is provided. We provide a tool to display the tradeoffs between guaranteeing revenue, guaranteeing enough water in the dam in the Summer months, and risk.

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