

Stochastic Dynamic Optimization of Bridge Design under Geomorphic Uncertainty

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ABSTRACT

"Designing bridges in mountain rivers requires accounting not only for flood loads and local scour, but also for long-term stochastic changes in riverbed elevation. Episodic aggradation and degradation may alter bed levels by several meters over time, producing two competing failure modes: insufficient deck clearance under aggradation and foundation exposure under degradation. The central challenge is therefore a decision problem under geomorphic uncertainty.

This talk presents a stochastic dynamic optimization framework for bridge design. Riverbed evolution is modeled as a Markovian stochastic process calibrated from field observations. An expected lifecycle cost functional is defined, incorporating initial construction cost and time-discounted reconstruction costs associated with future failures. The resulting Bellman recurrence relation is discretized to compute optimal design policies for bridge height and foundation depth conditional on the bed elevation at the time of construction.

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