

HETEROSCEDASTIC GAUSSIAN PROCESS REGRESSION FOR THE ROBUST DESIGN OF IMPERFECTION-SENSITIVE PRECAST BEAMS

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Keywords: lateral stability, prestressed concrete beams, Gaussian process, robust design optimization, structural reliability

Abstract

The susceptibility of long-span precast prestressed concrete girders to lateral instability during temporary loading phases such as transport, lifting and placement on bearings is well established. However, as spans have continued to increase, with some now exceeding seventy metres, failures continue to occur, underscoring the need for design approaches that explicitly account for uncertainty. Instability failures have been linked to the effects of initial imperfections arising from fabrication errors, creep, shrinkage and thermal effects. This paper presents a robust optimisation framework using a heteroscedastic Gaussian process surrogate to identify minimum-weight cross-sectional designs satisfying a probabilistic stress constraint under geometric and material uncertainty. The decomposition of predictive uncertainty into epistemic and aleatoric components afforded by this approach distinguishes regions of the design space where the surrogate lacks training data from regions where the structural response is inherently sensitive to parameter variability.