ABSTRACT

OPTIMAL LINEAR CONTROL OF INELASTIC STRUCTURES
USING AN EVOLUTIONARY GAIN FORMULATION TO
SATISFY PERFORMANCE OBJECTIVES

An optimal linear control-law formulation is developed herein using an evolutionary state-transition to meet various performance objectives in seismically excited structures. The control-law makes use of a predictive optimal linear control algorithm that is expanded using the Force Analogy Method to incorporate the nonlinear behavior of an inelastic structure. The optimal linear control algorithm developed herein uses an evolutionary gain approach (varying the gain per time step), which makes the control mechanism more adaptive to the needs of the system in real time. Convergence on an appropriate gain value is achieved by setting performance objectives for the system that the control mechanism is required to satisfy. This ensures that the control force applied to the system is not arbitrary, but has been verified, by calculation, to force the system to respond within an acceptable range of deflection. The solution is best able to satisfy performance objectives by limiting the amount of inelastic strain using a changing strain-based window of allowable deflections. Various control-law formulations are examined analytically using a "software testbed" and a theoretical single-degree-of-freedom benchmark structure. The optimal control-law formulation is the one that best mitigates structural and nonstructural damage while applying an achievable value of control force.

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