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Direct Determination of Critical Load Combinations for Elastoplastic Structures Subject to Multiple Load Cases

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The paper presents a mathematical programming based approach for the safety assessment of nonlinear structures that can be subject to a number of load combinations, for which dependent load patterns are also allowed. The objective of is to determine in a single step the critical load combination, for which the chosen maximum (or minimum) response (e.g. stress or displacement) occurs. Assuming elastoplastic material properties, the governing formulation takes the form of challenging nonconvex and nonsmooth optimization problem, known as a 0-1 mathematical program with equilibrium constraints (0-1 MPEC). The numerical algorithm proposed to solve the 0-1 MPEC is a regularization technique that involves iteratively processing a series of reformulated mixed integer nonlinear programming problems (MINLP) using a penalty.

Keywords: Complementarity, Elastoplastic materials, Integer program, Nonconvex optimization, Pattern loads, Uncertainties