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# A variational arc-length technique for the solution of elastoplastic problems

**J. Wambacq***, **G. Lombaert and S. François**

KU Leuven, Department of Civil Engineering

Kasteelpark Arenberg 40, 3001 Leuven, Belgium

*email: jef.wambacq@kuleuven.be

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Ultimate limit state analysis of structures commonly requires dealing with complex material behavior. Examples include materials such as concrete and masonry that are characterized by brittle fracture. Robust methods to trace the complete equilibrium path are therefore essential to accurately predict the ultimate limit state. However, classical algorithms often diverge due to strain localization and spurious non-physical local unloading that may occur in the post-critical regime.

In order to overcome these problems of classical arc-length methods, a number of alternatives have been proposed. Dissipation based schemes, such as the dissipation based arc-length method of Verhoosel et al. [1], try to stabilize the classical arc-length methods by imposing increments of the dissipated energy. For problems involving damage and plasticity this seems to be the most robust arc-length method currently available. However, the robustness and convergence of the algorithm depends on a critical choice of tuning parameters.

In this presentation, an alternative variational method is investigated. The methodology combines a minimum of potential energy approach [2] with an arc-length constraint. By using numerical optimization techniques, the equilibrium equations, compatibility equations, and constitutive behavior are concurrently treated in one single step. The performance of this methodology is compared to the performance of classical and energy-based arc-length methods on a number of cases such as the fracture of a perforated beam [1].

## REFERENCES

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