ADJOINT-BASED RECOVERY OF WEAKNESSES, MATERIAL PARAMETERS AND FORCES

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Abstract. Throughout the life cycle of products, processes or patients parts may weaken (e.g. due to corrosion, radiation) or age (e.g. in humans). It is therefore important to infer the state of systems (products, processes or patients) from measurements and high-fidelity computational models. Recent advances in software environments (set-up times for realistic geometries and material parameters), computational mechanics (commercial, open- source and academic codes) and sensors have made the task of accurately infering the state of a system possible, opening the way to high-fidelity digital twins.

The determination of weaknesses, material parameters or forces can be cast as as a high-dimensional optimization problem where on tries to minimize properly weighted differences of measured and computed values (displacements, strains, velocities, accelerations, etc.). The use of adjoints enables the relatively quick determination of the unknowns.

The paper will report on the considerable progress that has been made over the last year in the field, in particular extension to nonlinear materials, transient problems, uncertainty quantification, improved optimization techniques, and the effect of thermal fields (multiphysics).