

ON THE EVALUATION OF FINITE ELEMENT SENSITIVITIES TO NODAL COORDINATES*

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Abstract. We present a derivation of the derivative of general systems of finite element equations with respect to the coordinates of the nodes in the underlying finite element mesh. The resulting expressions allow the systematic evaluation of such derivatives without the need to resort to automatic differentiation or the expense associated with finite difference approximations. The principal motivation for this work comes from problems in optimal design, however, other potential applications are also described. The results obtained are validated through numerical examples.

Key words. adjoint, discrete adjoint, sensitivity analysis, differentiation, derivatives, finite element method, FEM, moving finite elements, moving mesh, moving nodes, nodal coordinates, node movement, node positions, shape derivative

AMS subject classifications. 65N30, 80M10, 49Q10, 49Q12

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