

E2-72: Some problems with first and second order optimisation methods

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Optimisation methods are now standard in solving inverse problems. In engineering, inverse problems are where we go beyond the analysis of a design and compute the design directly to match the performance required.

Non-statistical optimisation methods come in 3 forms, those of zeroth, first and second orders. While the latter 2 are far more powerful in terms of speed, the former 2 are relatively simpler in terms of implementation. This can be shown from known differentiable mathematical functions.

In real engineering however, object functions are numerically computed functions and are therefore not differentiable analytically. That is the derivatives lack accuracy. Further it has been shown that as mesh topologies of numerical schemes change in the process of design, the object functions lose their C^1 continuity. As a result the higher order schemes lose some of their power.

This paper examines these schemes in the light of these considerations and shows that second order schemes are always best not used and one ought to choose between zeroth and first order schemes.