Parameter identification in differential equations: A hybrid minimization based method

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Abstract: Ordinary and partial differential equations and systems of such equations are most often used to model physical phenomena and processes. The terms multiplying derivatives in these equations account for the physical properties of the media and strongly influence the spatial and time variation of the field variables governed by such equations. It is of utmost importance to provide correct values of the properties of the media. Since these media properties can be space and time dependent, their modeling is typically performed using analytic functions of the space and time where such functions involve a number of unknown parameters. Determining correct values of these parameters is known as parameter identification. Since this is a *de facto* inverse problem of quantifying the causes (parameters) of the measured (or specified) field and/or boundary conditions, the identification process is typically referred to as inverse parameter identification (IPI). There are many methods for performing IPI, but most of them are highly mathematical, not sufficiently robust and not general. This paper discusses and presents examples of a simple, robust, accurate and completely general methodology for IPI that is based on non-destructive measurements, a relatively small number of high-fidelity analyses, and use of metamodels.

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