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A Multigrid Approach for Three-Dimensional Inverse Heat Conduction Problems

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Abstract : A two-step multigrid approach is proposed to solve the inverse heat conduction problem in a 3-D object under laser irradiation. In the first step, the location of the laser center is estimated using a coarse and uniform grid system. In the second step, the front-surface temperature is recovered in good accuracy using a multiple grid system in which fine mesh is used at laser spot center to capture the drastic temperature rise in this region but coarse mesh is employed in the peripheral region to reduce the total number of sensors required. The effectiveness of the two-step approach and the multiple grid system are demonstrated by the illustrative inverse solutions. If the measurement data for the temperature and heat flux on the back surface do not contain random error, the proposed multigrid approach can yield more accurate inverse solutions. When the back-surface measurement data contain random noise, accurate inverse solutions cannot be obtained if both temperature and heat flux are measured on the back surface.

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