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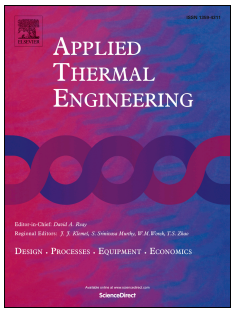

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An Adaptive Segmentation Haar Wavelet Method for Solving Thermal Resistance and Capacity Models of Ground Heat Exchangers

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Abstract

Increasingly complex numerical models are nowadays often utilized for studying ground source heat pump. The differential equation systems representing these models are often both large and stiff and can be hard to solve with conventional implicit methods. In this work, an adaptive step size segmentation Haar wavelet method is developed for solving large stiff ODE systems representing ground heat exchanger models in order to compute the ground temperature distribution over time. Three models are studied in this work : the cylinder-source model, a standing column well model and a vertical closed–loop borehole model. The proposed method is compared with the numerical differentiation formulas method of order 1 to 5 in terms of backward differences. Results indicate that, for a similar accuracy, the proposed method is 3 to 17 times faster than state-of-the-art commercial solvers.

Keywords: Haar wavelet method, thermal resistance and capacity, ground heat exchanger, closed-loop borehole, standing column well

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