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PARALLEL NUMERICAL ALGORITHMS FOR OPTIMIZATION OF ELECTRICAL CABLES

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In modern cars electrical and electronic equipment is of great importance. For engineers the main aim is to determine optimal conductor cross-sections in electro cable bundles in order to minimize the total weight of cables. A quantitative description of the thermo-electrical characteristics in the electrical cables can be obtained by using mathematical models based on parabolic partial differential equations. Let $T(X,t)$ describe a distribution of the temperature in electrical cables [1]:

$$\rho(X)c(X,T)\frac{\partial T}{\partial t} = \sum_{i=1}^{2}\frac{\partial}{\partial x_i}\Big(k(X)\frac{\partial T}{\partial x_i}\Big) + f(X,T), \quad (X,t) \in D \times (0, t_F], \tag{1}$$

Initial and boundary conditions:

$$T(X,0) = T_a, \quad X \in \bar{D} = D \cup \partial D, \tag{2}$$

$$k(X,T)\frac{\partial T}{\partial \eta} + \alpha_k(T)\big(T(X,t) - T_a\big) + \varepsilon\sigma\big(T^4 - T_a^4\big) = 0, \quad X \in \partial D. \tag{3}$$

We have proposed efficient parallel numerical algorithms for simulation of temperature distribution in electrical cables and have solved an inverse problem for fitting the diffusion coefficient of the air-isolation material mixture to the experimental data [2; 3]. The goal is to minimize the total mass of the metal in all wires under the constraints that the temperature of the wires remains bounded by some given maximal value. Since the formulated optimization problem is NP-hard, we restrict to an heuristic algorithm which is based on a greedy type search method. Parallel multilevel algorithms are developed using the master-slave and data decomposition paradigms [4]. Results of computational experiments are presented and the efficiency of the proposed parallel algorithms is investigated.

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