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Predictor-Corrector Methods for Solving Continuous Casting Problem

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Abstract: In this paper we present numerical approach to solve the continuous casting problem. The main tool is to use IPEC[1] method and DDM similar to [lapi] with multilevel domain decomposition. The general idea of these kind of algorithms is first to solve the problem in artificial boundaries (predictor step). After the solution at the boundaries is known then it can be used as Dirichlet type boundary condition and the noncoupled subdomain problems can be solved parallel. The last step of these methods is to correct the solution at the artificial boundaries (corrector step). The numerical results show the linear speedup of the IPEC-method.
The continuous casting problem can be stated as follows. Let Ω be an open bounded domain in $\mathbb{R}^2$ with boundary Γ, $T > 0$, $Q \equiv \Omega \times]0, T[$ and $\Sigma = \Gamma \times]0, T[$. The domain Ω is occupied by thermodynamically homogeneous and isotropic metal. We denote by $H(x, t)$ the enthalpy related to unit mass and by $u(x, t)$ the temperature for $(x, t) \in Q$. The continuous casting problem leeds to following boundary-value problem: find $u = u(x, t)$ such that

$$\begin{array}{ll} \dfrac{\partial H(u)}{\partial t} + v\dfrac{\partial H(u)}{\partial x_2} - \Delta u = 0 & \text{for } x \in \Omega,\ t > 0 \\ u = z(x_1, t) > 0 & \text{for } x \in \Gamma_1,\ t > 0 \\ \partial u/\partial n + au = g, \quad a \geq 0, g \geq 0 & \text{for } x \in \Gamma_2,\ t > 0 \\ u = u_0(x) > 0 & \text{for } x \in \bar{\Omega},\ t = 0. \end{array}$$

[1] A.V Lapin and J. Pieskä, *On the parallel domain decomposition algorithms for time-dependent problems*, Lobachevskii Journal of Mathematics, Vol. 10, p. 27-44, 2002. http://ljm.ksu.ru/vol10/lpp.htm

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[1] Implicit predictor-explicit corrector

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