COST 526

"Automatic Process Optimization in Materials Technology"

(APOMAT)

Half-Yearly Report

To be sent to **V.Tesch@access.rwth-aachen.de** until **February 28, 2003**

1. Reporting Period	**1.7.2002 – 31.12.2002**
Project title	Optimization of cooling parameters in continuous casting process
Project leader	Dr Erkki Laitinen
Organization	University of Oulu, dept. of mathematical sciences P.O. Box 3000 90014 UNIVERSITY OF OULU
Main collaborators involved	Helsinki Univ. of Technology, lab. of metallurgy, Finland Lab. for multiphase processes, Nova Gorica Polytechnic, Slovenia Banki Donat Polytechnic, Dept. of Material science and Technology, Hungary Rautaruukki steel company, Finland, Outokumpu steel company, Finland

2. Funding Situation	
Amount of money received specifically for COST	0 kEuros
Other resources partially used for the project	80 kEuros

3. International Collaboration

(mention group and type of work done in collaboration during the reporting period)

Participation in the Working Group Meeting in Budapest + project progress report

X YES

❒ NO

4. Industry participation

(mention name of companies and work done in collaboration during the whole project)

Rautaruukki steel, Finland: The new (modular) dynamic secondary cooling program is installed for commercial use.

5. Meetings, visits, exchange of scientists, short-term scientific missions	**Location, date**
Prof. A. Lapin, Prof. R. Dautov, Kazan State Univ., Russia	Oulu, Finland, August, 2002
Prof. R. Dautov, Kazan State Univ., Russia	Oulu, Finland, December, 2002

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6. Progress within the reporting period
(Not exceeding 3 pages, including tables and figures)

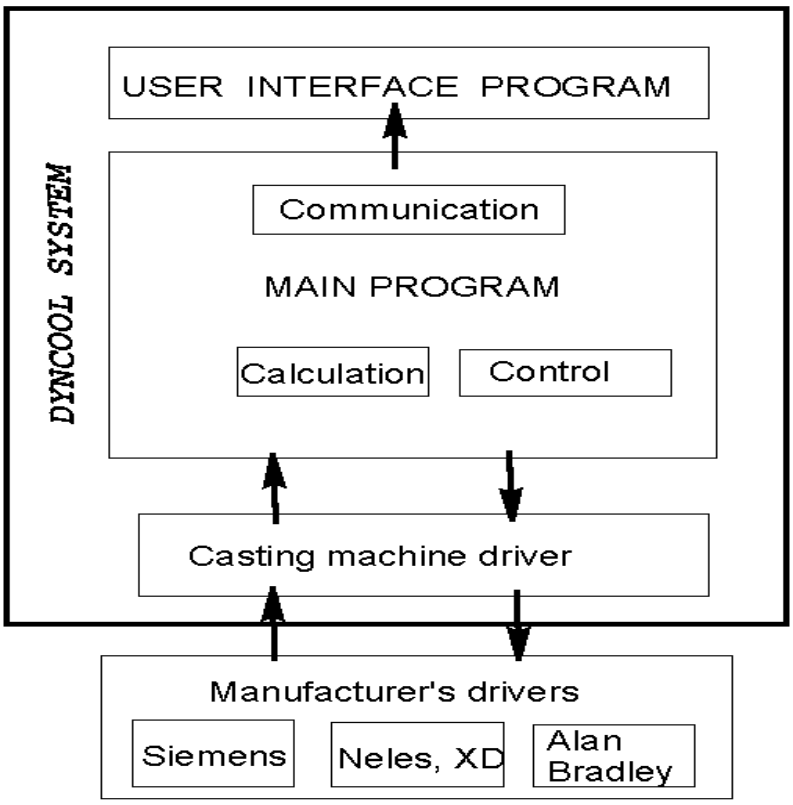
The main scientific work done during the last half year has been as follows:

Development of new modular structure of simulation program

The new simulation application has been done using CORBA architecture.
The GUI (user interface) and communication part (machine driver) are separate client programs for the main server application (simulation and control).

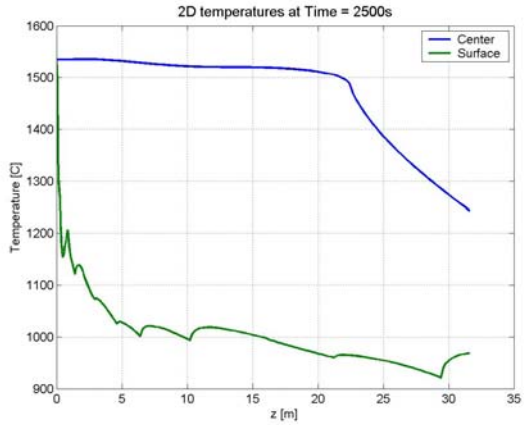
The highlights of new software are:

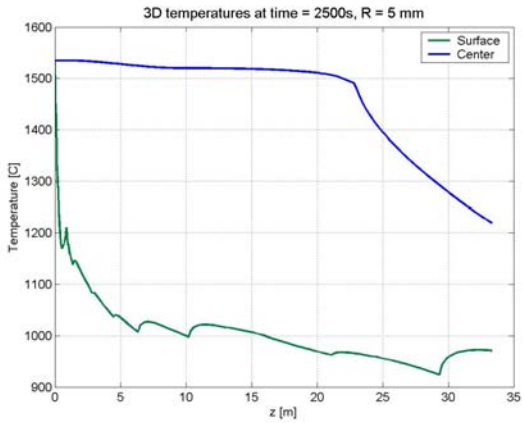
- better maintenance and compatibility
- drivers for different automation systems
- Dyncool program is now portable for different platforms
- updating of different modules (calculation, control, database, communication, etc.) easy
  easy programming of new client programs e.g.
  - creating and monitoring data base
  - monitoring real casting data
  - monitoring of the DYNCOOL program or data base is possible trough internet connection



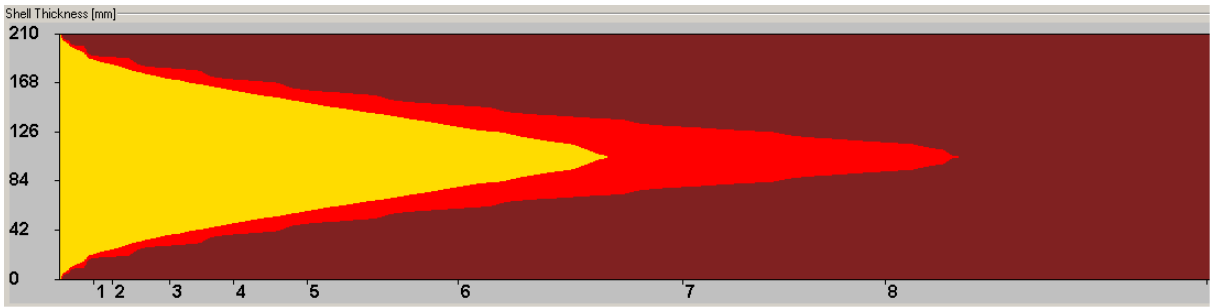
3D simulation model

The 3D simulation model for continuous casting model have been developed. It is numerically tested and results are compared with results calculated by existing 2D-model.
When comparing calculated surface and core temperatures it is hard to notice big differences between two models.

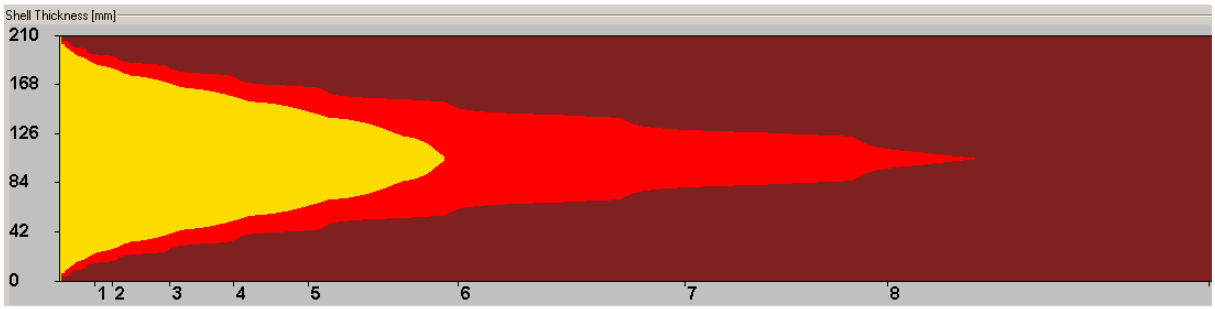




If we take a closer look and calculate the temperature field in the middle of the slab we see the big difference on liquid pool lengths (yellow area). However, the lengths of solid pools (red area) are almost the same.

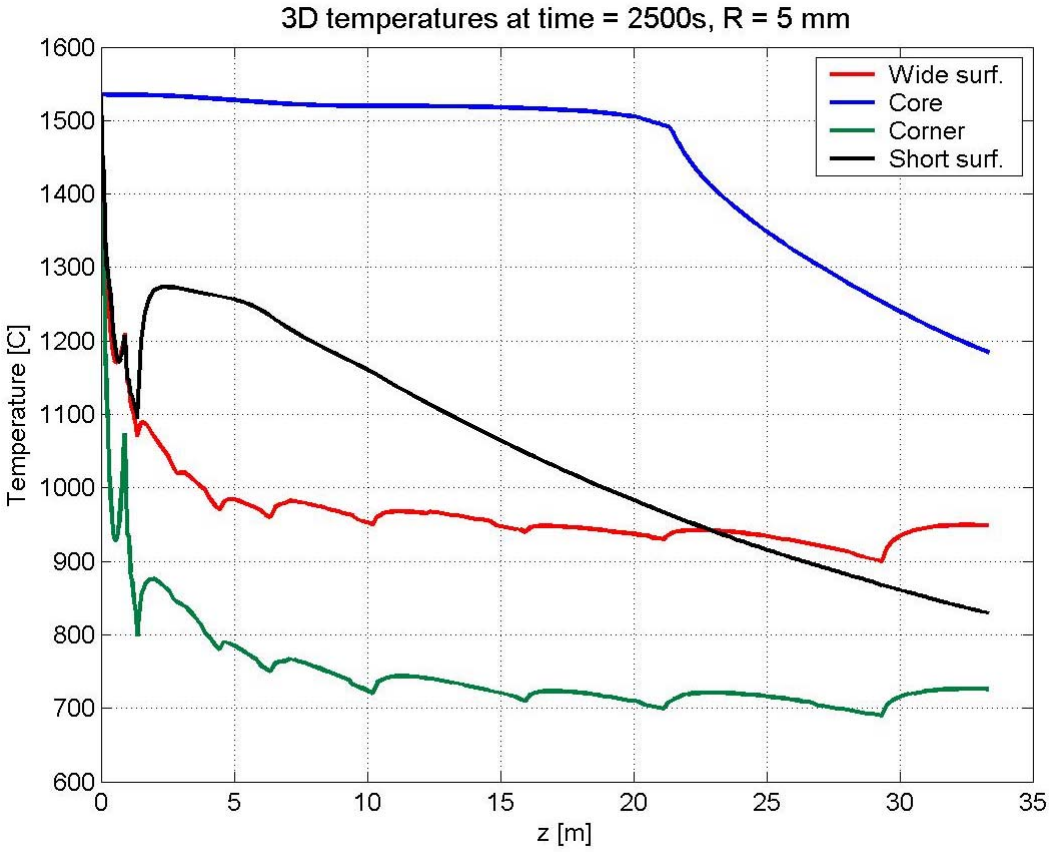


2D



3D

We also calculated the corner temperatures of the slab by using our 3D-model.



7. List of publications

a) Published

Lapin A., Pieskä J., 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

Laitinen E., Lapin A., Pieskä J., Asynchronous domain decomposition methods for solving continuous casting problem, Proceedings of the DD14 International Conference on Domain Decomposition Methods, Cocoyoc, Mexico, 2002, p. 459-466

b) Submitted for publications

A. Lapin, E. Laitinen and J. Pieskä:
"Asyncronous domain decomposition methods for continuous casting problem",
J. of Computational and Applied Mathematics

E. Laitinen, J. Pieskä, V. Toivonen: "On 3D-modelling and control of continuous casting process",
EUROTHERM 69, June 25-27, 2003, Lubljana, Slovenia

A. Lapin, E. Laitinen, J. Pieskä:"parallel solution of Stefan problem with prescribed convection",
in proc. of Parallel Computational Fluid Dynamics, May 13-15, 2003, Moscow, Russia

c) In preparation