COST 526

"Automatic Process Optimization in Materials Technology"

(APOMAT)

Half-Yearly Report

1. Reporting Period	**1.1.2003 – 30.06.2003**
Project title **Modelling and Optimisation for Competitive Continuous Casting** Project leader **Prof. Bozidar Sarler** Organization **Laboratory for Multiphase Processes** **Nova Gorica Polytechnic** **Vipavska 13, SI-5000 Nova Gorica, Slovenia** Main collaborators involved **Prof. Bogdan Filipic, SI** **Prof. Jaroslav Horsky, CZ** **Prof. Erkki Laitinen, FI** Industrial partners, steel: **ACRONI, SI** **INEXA-STORE, SI** **ISPAT NOVA HUT, CZ (through partner CZ)** **RAUTARUUKKI, FI (through partner FI)** Industrial partners, aluminium: **IMPOL, SI**	Project team: Nova Gorica Polytechnic **Igor Kovacevic** **Janez Perko** **Robert Vertnik** **Miha Zaloznik** ACRONI **Ales Lagoja** **Jozef Triplat** **Emil Subelj** INEXA-STORE **Gojko Manojlovic** **Janko Cesar** IMPOL **Rajko Safhalter** **Edvard Slacek** **Marina Jelen** **Franci Tomazini** **Viljem Strnad**

2. Funding Situation	
Amount of money received specifically for COST	5kEuros
Other resources partially used for the project	45kEuros

3. International Collaboration (mention group and type of work done in collaboration during the reporting period)
Participation in the Working Group Meeting in Brussels + project progress report **YES, project presented by Prof. Bozidar Sarler**

4. Industry participation (mention name of companies and work done in collaboration during the whole project)
The project is connected to four steel companies and one aluminium company. Already mentioned, see the research group.

5. Meetings, visits, exchange of	**Location, date**

scientists, short-term scientific missions	
E.Laitinen, short term scientific mission To IJS and PNG. Regular contacts with project partners.	Slovenia, end of June 2003

6. Progress within the reporting period

(Not exceeding 3 pages, including tables and figures)

The advances in the reporting period have been focused on optimization of the simulation system solver. In recent years a number of mesh-free methods have been developed to circumvent the problem of polygonisation encountered in the classical numerical methods. In mesh-free methods the approximation is constructed entirely in terms of a set of gridpoints. A class of such methods is based on the collocation with radial basis functions. Kansa used them for a scattered data approximation, and afterwards for a solution of the partial different equations (PDEs). The key point of the radial basis function collocation method (RBFCM) is the approximation of the fields on the boundary and in the domain by a set of global approximation functions. The main advantage of using the RBFCM for solving the PDEs is in its simplicity, applicability to different PDEs, and effectiveness in dealing with arbitrary dimensions and complicated domains. But the most important disadvantage of using the RBFCM is the solution of system linear equation which in some situation can be ill-conditioned. This drawback has been eliminated by using RBF's in the context of diffuse approximate method, where the moving least squares approximation has been introduced instead of global interpolation. A systematic comparison of this method has been made with the finite volume method. The same accuracy has been achieved by approximately three times more computer time, however with the advantage of no mesh. This method is now further investigated in the context of optimization of the macro-segregation profile in D.C. casting of aluminum alloys, where the finite volume method failed to give mesh independent results with reasonably fine meshes. The method promisses to be extremely useful also in static casting simulations.

7. List of publications

a) Published

B.Sarler, D.Gobin (eds.), Proceedings of the seminar EUROTHERM 69: Heat and Mass Transfer in Solid-Liquid Phase Change Processes, June 25-27, 2003, Bistra Castle, Ljubljana, Slovenia, Založba Politehnike Nova Gorica, 2003.

B.Sarler, R.Vertnik, R.Trelc, E.Subelj, A.Lagoja, J.Triplat, G.Manojlovic, J.Cesar, A simulation system for continuous casting of steel, B.Sarler, D.Gobin (eds.), Proceedings of the seminar EUROTHERM 69: Heat and Mass Transfer in Solid-Liquid Phase Change Processes, June 25-27, 2003, Bistra Castle, Ljubljana, Slovenia, Založba Politehnike Nova Gorica, 2003, pp.195-212.

I.Kovacevic, B.Sarler, A radial basis function collocation solver for transport phenomena in continuous casting of aluminum alloys, B.Sarler, D.Gobin (eds.), Proceedings of the seminar EUROTHERM 69: Heat and Mass Transfer in Solid-Liquid Phase Change Processes, June 25-27, 2003, Bistra Castle, Ljubljana, Slovenia, Založba Politehnike Nova Gorica, 2003, pp.195-212.

B.Sarler, I.Kovacevic, C.S.Chen, Radial basis function collocation solution of temperatures in D.C. cast aluminium alloy billets, A.Mammoli, J.Ingber (eds.), Moving Boundaries VII, WIT Press, Southampton, 2003, pp. 55-62.

b) Submitted for publications

c) In preparation

B.Sarler, J.Perko, R.Vertnik, The diffuse approximate method based on radial basis functions for simulation of casting transport phenomena, Int.J.Numer.Methods Eng.