

COST 526 - 'Automatic Process Optimization in Materials Technology' – (APOMAT)
Final Report – 31 July 2005
Summary sheet

Project Code	D1
Title	“Simulation-based optimization in sheet metal forming”
Project Leader	Prof. Dr.-Ing. M. Grauer
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Main collaborators involved	Juniorprof. Dr.-Ing. T. Barth

Funding Situation (for the whole project)

Amount of money received specifically for COST	0 kEuros
Other resources partially used for the project	360 kEuros
(project ViPro 2002-2004: 160 k€, project MiGrid 2004-2006: 200 k€)	

International Collaboration (mention group and type of work done in collaboration during the whole project)

Dr. M. Makowski (IIASA, Laxenburg/Austria) on complex system modelling

Prof. J.-L. Batoz (Institut Supérieure d'Ingénierie de la Conception, Saint-Dié des Vosges/France) and
 Dr. C. Knopf-Lenoire (Université de Technologie de Compiègne, Compiègne/France)

on simulation and optimization of sheet metal forming processes

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

GEDIA Gebrüder Dingerkus GmbH, Röntgenstr. 2, D-57439 Attendorn/Germany
 Fischer & Kaufmann GmbH & Co. KG, Am Steinwerk 7, D-57413 Finnentrop/Germany
 Egon Großhaus GmbH & Co. KG, Bonzelerhammer, D-57368 Lennestadt/Germany
 HMT Heldener Metall Technik GmbH, Biggen 12, D-57439 Attendorn/Germany
 Albert Hiby GmbH & Co. KG, Grünestr. 32, D-58840 Plettenberg/Germany

Case studies, R&D collaborations on analyzing commercial product and process design for deep drawn parts and formulation of relevant optimization problems.

INPRO Innovationsgesellschaft für fortgeschrittene Produktionssysteme in der Fahrzeugindustrie mbH, Hallerstr. 1, D-10587 Berlin/Germany
 GNS Gesellschaft für numerische Simulation mbH, Am Gaußberg 2, D-38114 Braunschweig/Germany
 PROCAD GmbH & Co. KG, Vincenz Prießnitz-Str. 3, D-76131 Karlsruhe/Germany
 Co.Com Concurrent Computing GmbH, Am Eichenhang 50, D-57076 Siegen/Germany

- Evaluating FE-simulation software FETI/FETI-INDEED and product data management system PRO*FILE for their use in software environments to support product and process design in sheet metal forming
- Prototypical implementation of a service-based software system to support distributed simulation-based optimization.

Meetings, visits, exchange of scientists, short term scientific missions (mention main events during the whole project)	Location, date
Workshops "Grid Computing for SME"	University of Siegen, 3.3.2005 University of Siegen, 17.7.2003
Workshop "Product Lifecycle Management for SME"	University of Siegen, 3.5.2004
Kick-off meeting "MiGrid"	University of Siegen, 21.9.2004

Main Outcome of the project (mention only the major points)

- comprehensive understanding of the knowledge-intensive process of product and manufacturing process design in the field of sheet metal forming in automotive supplier industry
- distributed simulation-based solution approach to multistage manufacturing problems in sheet metal forming developed and analyzed regarding parallel speedup and efficiency from one up to 200 CPUs
- prototypical implementation of a service-oriented software system to support product and process design based on standards from Grid Computing (GLOBUS toolkit V4)
- experiences in using heterogeneous high-performance computing resources (networks of workstations, personal computers, cluster systems) for simulation-based optimization in industrial scenarios

Publications, related to this project

Published

Gerdas, Markus ; Barth, Thomas ; Grauer, Manfred: Performance analysis of distributed solution approaches in simulation-based optimization. In: ***Computational Management Science*** 2 (2005), Nr. 1, pp. 57-82

Grauer, Manfred: Einsatz von Grids in der Automobilindustrie. In: ***Wissensmanagement*** (2005), Nr. 1, p. 13

Arndt, Olaf ; Barth, Thomas ; Freisleben, Bernd ; Grauer, Manfred: Approximating in finite element model by neural network prediction for facility optimization in groundwater engineering. In: ***European Journal of Operational Research*** 166 (2005), pp. 769-781

Kaden, Stefan ; Grauer, Manfred: Optimized groundwater management. In: **Makowski, Marek** (ed.) : ***CSM'04 (18th Workshop on Methodologies and Tools for Complex System Modeling and Integrated Policy Assessment Laxenburg 06.-08.09.2004)***. Laxenburg : IIASA, 2004, p. 26.

Grauer, Manfred ; Barth, Thomas: Grid Based Computing for Multidisciplinary Analysis and Optimization . In: **Messac, Achille ; Renaud, John E.** (eds.) : ***MDO: Reshaping Design in Industry (10th AIAA/ISSMO Multidisciplinary Analysis and Optimization Conference Albany 30.08.2004 - 01.09.2004)***. Albany : American Institute of Aeronautics and Astronautics, 2004, pp. 1-10.

Grauer, Manfred ; Barth, Thomas ; Thilo, Frank: Distributed Simulation-based Optimization in Decision Support and Management. In: **Leena Suhl ; Stefan Voß** (eds.) : ***Quantitative Methoden in ERP und SCM***. Vol. 2. Paderborn : DS&OR Lab, Uni Paderborn, 2004, pp. 1-13. - ISBN 3-8334-0848-0

Grauer, Manfred ; Barth, Thomas ; Thilo, Frank: About Distributed Simulation-based Optimization of Forming Processes using a Grid Architecture. In: **Makowski,**

Marek (eds.) : **CSM'04** (18th Workshop on Methodologies and Tools for Complex System Modeling and Integrated Policy Assessment Laxenburg 6.-8.09.2004). Laxenburg : IIASA, 2004, p. 17.

Grauer, Manfred ; Barth, Thomas: About Distributed Simulation-based Optimization of Forming Process Using a Grid Architecture. In: **Ghosh, S. ; Castro, J.M. ; Lee, J.K.** (eds.) : **Materials Processing and Design: Modeling, Simulation and Applications** (NUMIFORM 2004 Columbus, Ohio/USA 13. - 17.06.2004). Vol. 712. Columbus, Ohio/USA : Springer, 2004, pp. 2097-2102. - ISBN 0 -7354- 0189-6

Grauer, Manfred ; Stuff, G. ; Barth, Thomas ; Neuser, Peter ; Reichert, Oliver ; Gerdes, Markus: Virtual Prototyping in Manufacturing based on Complex System Modeling. In: **IIASA** (eds.) : **Methodologies and Tools** (17th JISR-IIASA Workshop on Methodologies and Tools for Complex System Modeling and Integrated Policy Assessment Laxenburg, 8.-10.9.2003). Laxenburg/Austria : IIASA, 2003.

Gerdes, Markus ; Barth, Thomas ; Grauer, Manfred: About Performance-Models for the Distributed Solution of Simulation-Based Optimizations in Engineering . In: **Journal of Computational Methods in Science and Engineering (JCMSE)** 3 (2003), Nr. 3, pp. 269-281

Grauer, Manfred ; Barth, Thomas ; Gerdes, Markus: Concept and First Experiences in Simulation-Based Optimization . In: **Center for Computational Materials Science, Institute for Materials Research, Tohoku University, Sendai , Japan** (ed.) : **Proceedings der Fourth International Conference on Intelligent Processing and Manufacturing of Materials** (Intelligent Processing and Manufacturing of Materials Sendai/Japan 18.5.-23.5.2003). 2003, (on CD).

Grauer, Manfred: Grid Technology for Virtual Prototyping as an Infrastructure in Future Manufacturing. In: **Andrzej P. Wierzbicki** (ed.) : **Importance of ICT for Research and Science** (4th Global Research Village Conference Warschau 10-11 Oct. 2002). Warschau : Information Processing Center, 2003, pp. 172-173.

Grauer, Manfred ; Barth, Thomas: Kollaboratives virtuelles Prototyping . In: **Industrie Management** 19 (2003), Nr. 5, pp. 29-32

O. Arndt ; Barth, Thomas ; B. Freisleben ; Gerdes, Markus ; Grauer, Manfred: Using Adaptive Neural Network Predictions in Black-Box Optimization. In: **Aliew, Fuad** (ed.) : **Application of Fuzzy Systems and Soft Computing** (Fifth International Conference on Application of Fuzzy Systems and Soft Computing (ICAFS'02) Milano/Italy 17.9.-19.9.2002). 2002, pp. 112-120.

Barth, Thomas ; Grauer, Manfred: Grid Computing-Ansätze für verteiltes virtuelles Prototyping. In: **D. Schoder ; K. Fischbach ; R. Teichmann** (eds.) : **Peer-to-Peer - Ökonomisch, technologische und juristische Perspektiven**. Berlin : Springer, 2002, pp. 153-172.

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Mathematical Models in Science and Engineering (CMMSE'02) Alicante/Spain 20.9.-25.9.2002). 2002, pp. 132-140.

Barth, Thomas ; Freisleben Bernd ; Gerdes, Markus ; Grauer, Manfred ; Arndt Olaf: A hybrid global and local search approach using prediction in simulation-based optimization. In: **IEEE** (eds.) : ***Bridging the digital divide, 2002 IEEE International Conference on Systems, Man and Cybernetics Hammamet/Tunesien 6.10.9.10.2002***). Bd. 3. Hammamet : IEEE, 2002, pp. 435-445.

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Grauer, Manfred ; Barth, Thomas ; Beschorner, Christian ; Bishopink, J. ; Neuser, Peter: Distributed scalable optimization for intelligent sheet metal forming . In: **Meech, J.A. ; Veiga, S.M. ; Veiga, M.M. ; LeClair, S.R. ; Maguire, J.F.** (eds.) : ***Proceedings of the 3rd Int. Conf. on Intelligent Processing and Manufacturing of Materials (Intelligent Processing and Manufacturing of Materials Vancouver 2001)***. Vancouver : IPMM, 2001, (auf CD).

Schneider, G. ; Barth, Thomas ; Stettner, M. ; Grauer, Manfred ; Hörnlein, H. ; Kereku, Edmond: Multidisciplinary Design Optimisation of an Aircraft Wing by Applying a Hybrid Optimization Strategy. In: **Parmee, Ian** (ed.) : ***Optimization in Industry III (Optimization in Industry III Barga/Italy 2001)***. 2001, pp. 102-113.

Submitted for publication

Grauer, Manfred; Barth, Thomas; Gerdes, Markus; Reichwald, Julian: About a service-oriented software architecture for simulation and optimization in sheet metal forming. *Accepted contribution at Intelligent Processing and Manufacturing of Materials (IPMM'2005) 19.-23.7.2005 in Monterey, CA, USA.*

In preparation

Will you continue the actual cooperation with your partners after the end of the action?

Yes

No

Would you participate in a possible "spin-off" action continuing the present one?

Yes

No

Will you continue your present work/collaboration with another European action?

Yes

No