KTH Mechanics

SE-100 44 Stockholm, Sweden

Activity Report 2006

Contents

Preface

This report gives a short overview of the structure and activities at the department of Mechanics, KTH during the year of 2006. More information may be found at the department web site http://www.mech.kth.se.

The teaching activity of the mechanics department during the year of 2006 included basic mechanics courses given for a majority of the students at various schools in KTH.

The scientific activity of the department resulted in the defence of 10 doctoral and 7 licentiate thesis during 2006. The publication list of the staff and graduate students of the mechanics department this year amounted to 32 publications in archival journals, 12 publications in conference proceedings and 15 internal reports.

Stockholm, June 2007

Dan Henningson, department chairman

Nicholas Apazidis, department vice chairman

1 Introduction

Department of Mechanics is one of the 6 departments of the School of Science at KTH. The Department had 93 employees and a turnaround of about 63 MSEK during the year of 2006.

Prof. Dan Henningson is the chairman of the department and docent Nicholas Apazidis is the vice chairman. Docent Hanno Essén is the director of undergraduate studies. Docent Anders Dahkild is the director of graduate studies. Functions of the board of the department are now partially executed at the general level of the School of Science. Issues that are specific for the department are discussed and managed by the two groups at the department level. Those are the management group consisting of: Henrik Alfredsson, Gustav Amberg, Nicholas Apazidis, Fritz Bark, Anders Eriksson, Hanno Essén, Dan Hennigson (chairman), Arne Johansson, Hans Silverhag and the administrative group consisting of: Nicholas Apazidis, Dan Hennigson (chairman), Hanno Essén, Erik Lindborg, Arne Nordmark, Hans Silverhag and Ingunn Wester.

The educational activity at the department for the undergraduate studies offers a comprehensive course selection in basic mechanics attended by 1 500 students, in fluid mechanics with 500 students and in structural and advanced mechanics with 250 students. With about 90 staff, including 9 professors and 14 associate professors the department is large enough to provide an excellent research environment in a wide range of research areas for about 40 graduate students. During the academic year of 2006, 10 of the graduate students defended their PhD thesis and 7 their Licentiate thesis.

The department also serves as one of the hosts, together with the Department of Solid Mechanics of the International Masters Programme in Engineering Mechanics which offers a broad spectrum of higher level courses in solid and fluid mechanics. Dr. Jean-Marc Battini serves as the coordinator of this program at the department.

Mechanics of solids, fluids and gases are fundamental areas within classical physics and plays a pivotal role in the design and analysis in almost every branch of engineering science. Today, this position is enhanced by even larger amount of the areas engulfed by the subject. For instance, chemical and material sciences in combination with fluid mechanics lead to a deeper understanding of various physical phenomena and also leads to new technical innovations. The research methods of mechanics are well established and are successfully used for example in biological sciences with application to human body. Such a cross-scientific approach opens new possibilities for a better understanding of a human body (from cells to muscles and locomotion). These exciting new areas go hand in hand with the more traditional applications in a multitude of technological processes used in construction, transportation, paper manufacturing, electrochemical and pharmaceutical industries generating new and challenging research problems. The researchers in the department are divided in 7 research groups.

- The group of *Structural Mechanics* (headed by Prof. Anders Eriksson) studies advanced load-carrying structures in both natural and man-made

contexts. Numerical models are used to solve the force distributions, based on theories of static and dynamic equilibrium. The main applications in recent years have been on one hand deployable structures for, e.g., space applications, and on the other hand the human musculoskeletal system. For the latter, both the muscular force production, and the neuro-muscular motion planning have been major study areas.

- In the *Stability, Transition and Control* group (headed by Prof. Dan Henningson) studies dealing with how and why orderly laminar fluid transitions to chaotic turbulent flow are performed. Often large scale numerical experiments are used to predict this process. In the area of flow control and optimization a step further from just analyzing and understanding flows is taken, and deals with how flows can be manipulated and optimized in order to achieve the objectives at hand. Research is performed in cooperation with universities, research institutes and industry worldwide, e.g. in projects funded by the European Union.

- *The Fluid Physics Laboratory* (headed by Prof. Henrik Alfredsson) is located in "Flyghuset" at Teknikringen 8 but is a part of the Department of Mechanics. The laboratory is well equipped with modern measurement equipment for fluid flows and several unique research rigs. Five main research areas can be identified at present: fundamental studies of transition to turbulence in boundary layer flows, high Reynolds number and complex turbulent flows with heat transfer, fibre suspension flows related to paper industry, internal compressible flows and shock wave research with applications to shock focusing. The compressible flow research is coupled to KTH CICERO, Center for Internal Combustion Engine Research Opus, where gas management of IC engines are studied with the aim to increase efficiency and thereby significantly reduce emissions of CO_2. Although most research projects within the laboratory are of fundamental character collaboration with industry (e.g. aeronautical, vehicle and paper industry) is common.

- *The Turbulence group* (headed by Prof. Arne Johansson) is active in different areas of turbulence research, including modelling and simulations of high Reynolds number flows, development of subgrid models for Large Eddy Simulations (LES), pressure measurements in high Reynolds number flows and measurements in high Reynolds number turbulent boundary layers. Recent developments also include studies of combustion in turbulent flows. Another growing research area is the study of geophysical flows through theoretical development and simulations, in particular flows subjected to strong stratification. A new research subject is the study of quasi-geostrophic turbulence, that is large scale turbulence strongly affected by the combined effects of rotation and stratification.

- In the group of *Physio-chemical fluid mechanics* (headed by Prof. Gustav Amberg) research dealing with fluid mechanics dominated by effects such as capillarity, phase change, heat and mass transfer, etc, are studied. Examples of application areas are micro fluidics and materials processes.

- *The research group for Fluid Mechanics of the Process Industries* (headed by Prof. Fritz Bark) investigates applied problems, often in combination

with other disciplines in the engineering sciences. Examples of research themes are multi-component, multiphase non-isothermal flow in polymer electrolyte fuel cells, electro permutation assisted by ion exchange textiles, multiphase hydrodynamic/electrochemical modelling of pickling of steel and investigations of the mechanics of fiber suspensions.

- In the group of *Theoretical and Applied Mechanics* (headed by Dr. Hanno Essén) research is performed in the following areas: dynamical systems with discontinuous forces, non-linear acoustics, statistical mechanics with magnetic interaction forces, kinetic gas theory, and asymptotic methods in classical and quantum mechanics.

Highlights 2006

During 2006 the department hosted a European Fluid Mechanics Conference and two new research centra affiliated to the department have been initiated.

- The 6th European Fluid Mechanics Conference 6 (EFMC6) was successfully held at KTH, Stockholm during the period June 26-30, 2006. Nine invited lectures and more than 400 contributed papers were presented during the five day conference which took place in the main buildings at KTH Campus. Also five mini-symposia were arranged during the conference with topics such as "New developments in hydrodynamic stability theory" and "Vehicle aerodynamics". Veronica Eliasson, KTH Mechanics and Simone Camarri, University of Pisa were selected by the EFMC scientific committee for the EUROMECH Young scientist award. The title of the presentation by Eliasson was "Focusing of strong shocks in an annular shock tube".

- KTH CICERO (Center for Internal Combustion Engine Research Opus) is a competence center started on January 1, 2006, CICERO is supported by the Swedish energy agency and the main industrial vehicle companies active in Sweden (GM PT, Scania CV, Volvo Cars, Volvo PT). At the School of Science two research divisions are at present involved; the Fluid physics laboratory (Department of Mechanics) and the Marcus Wallenberg Laboratory (MWL) (Department of Aeronautical and Vehicle Engineering). The center is organized through the ITM School where also the division of Internal combustion engines (Department of Machine Design) is a partner. Its director is prof. Henrik Alfredsson, KTH Mechanics.

  CICERO is devoted to the development of energy efficient and environmentally friendly IC engines through active use of "gas management", where turbo charging is a central theme. Development of the gas management system is of crucial importance for making the combustion engine more effective which e.g. will decrease the emissions of CO_2.

- The Linne Flow Center (FLOW) is one of 20 original centers of excellence set up by the Swedish Research Council (VR), as the result of highly competitive process with international evaluation. KTH Mechanics was awarded 50 MSEK over a period of 10 years, staring July 1, 2006. The center was established during the fall of 2006 with the vision of creating

an outstanding environment for fundamental research in fluid mechanics, where innovative research is born and future research leaders are fostered. Partners in the center are, in addition to KTH Mechanics, the Marcus Wallenberg Laboratory (MWL) and the Numerical Analysis group at the School of Computer Science and Communication. The main themes of the center are stability and transition, flow control, turbulence and geophysical flows, micro-fluid flows, aero-acoustics and numerical analysis. We envisage the center as an attractive meeting point for fluid mechanics researchers worldwide.

Personnel related matters during 2006

New appointments during 2006

Dr Minh Do-Quang was appointed as researcher

Dr Daniel Söderberg was appointed as docent in fluid physics

Dr Jens Fransson had docent lecture in December 2006 and was appointed as docent in fluid physics in February 2007

During 2006 8 new graduate students started at the department.

Miscellaneous

Department meeting combined with a boat trip in the beautiful surroundings of Stockholm archipelago was held towards the end of the spring, on June 14 2006. By the end of 2006 the Christmas dinner was arranged at Ulriksdals Wärdshus.

2 Personnel

Professors

- Henrik Alfredsson, Ph.D. in mechanics, KTH 1983 and Docent there 1985. Professor of fluid physics 1989. Director of CICERO.
- Gustav Amberg, Ph.D. in fluid mechanics, KTH 1986, Docent at KTH 1990. Professor of fluid mechanics 1999. Dean of the school of engineering sciences, since December 1, 2004.
- Fritz Bark, Ph.D. in Applied Mechanics at KTH 1974. Professor of Hydromechanics, 1985.
- Anders Eriksson, Ph.D. in steel structures, KTH 1981 and Docent there 1988. Professor of structural mechanics 1992. Vice president of KTH since 1999.
- Dan Henningson. Ph.D. KTH 1988, Docent KTH 1992. Professor of fluid mechanics since 1999 . Department chairman since July 2005. Director of KCSE (KTH Computational Science and Engineering Centre) since July 1, 2004. Director of Linné Flow Center
- Arne Johansson, Ph.D. in mechanics, KTH 1983 and Docent there 1984. Professor of mechanics 1991. Appointed secretary general for Natural and Engineering Sciences at the Swedish Research Council (VR) since July 1, 2004 (75% at VR, 25% at KTH).

Adjunct professors and guest professor

- Laszlo Fuchs, Ph.D. in Gasdynamics 1977, Docent KTH 1980. Prof. fluid mechanics LTH 1994–present. Guest Prof. (20%) at KTH Mechanics 1994–present.
- Ardeshir Hanifi, Ph.D. in fluid mechanics 1995, Docent KTH 2003. Adj. prof. of fluid mechanics 2005 20%, 80% FOI.
- Per-Olof Thomasson, Ph.D. in 'Ståbyggnad' 1978, Docent KTH 1978. Employed 20% as Adj. Prof. of applied structural mechanics 2002.
- Said Zahrai, Ph.D. in mechanics 1992, Docent KTH 1998, Employed 20% as Adj. Prof. of fluid mechanics at KTH 2002, and 80% at ABB Corp. Res.

Professors emeritii

- Bengt Enflo, Ph.D. and Docent 1965 in theoretical physics, Univ. of Stockholm. 'Biträdande professor' at KTH 1996. Retired in 2000, but still active in research at KTH Mechanics.

- Martin Lesser, Ph.D. in Aerosp. Eng. at Cornell., Docent and Prof. at LuTH. Professor of mechanics at KTH 1987. Retired in May 2005, but still active in research at KTH Mechanics.

Senior Lecturers (in Swedish: lektorer)

- Nicholas Apazidis, Ph.D. in mechanics, KTH 1985, Docent at KTH 1994. Department vice chairman since 2005.
- Anthony Burden, Ph.D. in applied mathematical physics, CTH 1984.
- Anders Dahlkild, Ph.D. in mechanics 1988 and Docent 1992 at KTH. Vice director and scientific secretary of the Faxén Laboratory. Director of graduate studies.
- Hanno Essén, Ph.D. in theoretical physics Univ. of Stockholm 1979. Docent 1986. Director of undergraduate studies.
- Richard Hsieh, Ph.D. in mechanics 1978, Docent at KTH 1980.
- Arne Karlsson, TeknL. (50 % at KTH Mechanics.)
- Göran Karlsson, Ph.D. in quantum chemistry 1970 Univ. of Uppsala.
- Erik Lindborg, Ph.D. in Mechanics KTH 1996, Docent at KTH 2001.
- Arne Nordmark. Ph.D. in mechanics 1992. Docent 1999.
- Christer Nyberg, Ph.D. in mechanics 1979 KTH.
- Lars Söderholm, Ph.D. and Docent 1970 in theoretical physics, Univ. of Stockholm.
- Lars Thor, Ph.D. in mechanics at KTH 1973.
- Karl-Erik Thylwe, Ph.D. 1981 in theoretical physics, Univ. of Uppsala. Docent 1987.

Lecturers, research associates and researchers

- Jean-Marc Battini, Ph.D. in Structural mechanics 2002
- Luca Brandt, Ph.D. in Fluid mechanics 2003.
- Geert Brethouwer, Ph.D. in Fluid mechanics, TU Delft 2001.
- Jens Fransson, Ph.D. in Fluid mechanics 2003.
- Elena Gutierrez Farewik, Ph.D. in Orthopedics, KI 2003.
- Fredrik Lundell, Ph.D. in Fluid mechanics 2003.
- Gunnar Maxe ('adjunkt').
- Gunnar Tibert ('forskarassistent'), Ph.D. in Structural mechanics 2002.

- Nils Tillmark, Ph.D. in Fluid mechanics 1995. Responsible for the department's lab. facilities.
- Michael Vynnycky ('förste forskare'), Ph.D. Univ. of Oxford, Docent at KTH 2002.
- Peter Yakubenko ('forskare'), Ph.D. in hydraulic engineering 1996. Researcher, Faxén Laboratory.
- Galina Shugai, Ph.D. 2000 at KTH, Researcher, Faxén Laboratory.

Adjunct Lecturers

- Daniel Söderberg, Ph.D. in fluid mechanics 1999. Adjunct lecturer in fluid mechanics with paper manufacturing application (20% at KTH, 80% at STFI/Packforsk).
- Stefan Wallin, Ph.D. in Fluid Mechanics 2000. Adjunct lecturer in fluid mechanics with turbulence modelling application, (40% at KTH, 60% at FOI).

Guest researchers, post-docs

- *Guest lecturer*: Prof. Alessandro Talamelli, Univ. of Bologna, Italy (3 months)
- Guest researcher: Dr. Rock de Lange, TU (2 months)
- *Post-doc*: Dr. Olaf Marxen (Apr 2005–June 2006)
- *Post-doc*: Dr. Petri Piiroinen (Jan 2006–Dec 2006)
- *Post-doc*: Dr. Philip Schlatter (Sept 2005–Dec 2006)
- *Post-doc*: Dr. Shino Tanaka (June 2006–Sept 2007)
- *Post-doc*: Dr. Likang Yang (Sept 2006–Sept 2007)

Technical and administrative staff

- Lars Bjernerstam
- Pär Ekstrand
- Marcus Gällstedt
- Ulf Landén
- Anne-Mari Olofsson
- Hans Silverhag (administrativ chef)
- Stefan Skult
- Viviana Wallin
- Ingunn Wester (chefsadm./personalansvarig)

Changes in the department personnel during the last 7 years are summarized in the following table

Number of employees during 2000-2006							
Position	2000	2001	2002	2003	2004	2005	2006
Prof./Adj. Prof.	8	9	11	11	10	10	10
Lect./Adj. Lect.	13	14	15	16	16	16	16
Ass. lect./Researcher/Adjunct	7	7	7	9	11	12	12
Adm. personnel	8	9	9	10	10	9	9
Guest Res./Post-docs				3	5	5	4
Doctoral students	47	48	45	46	42	38	37
External doct. stud.	16	14	12	6	11	8	6
Total	99	101	99	101	105	98	94

Active graduate students at KTH Mechanics during 2006					
Name	Affiliation	Adv.	Start	TeknL	TeknD
Daniel Ahlman	Mech	AJ/GB	07/2002		
Peter Andrén	Mech	AE		05/2006	
Shevrin Bagheri	Mech	DH	04/2006		
Gabrielle Bellani	Mech	HAL/FL	02/2006		
Olle Bodin	Mech	LF	09/2006		
Martin Byström	Mech	DH	02/2005		
Allan Carlsson	Mech	DS/FL	01/2005		
Carl-Ola Danielsson	Mech/FLA	AD	01/2001	11/2004	06/2006
Veronica Eliasson	Mech	NA/NT	02/2003	12/2005	
Luca Facciolo	Mech	HAL/NT	06/2001	11/2003	03/2006
Bengt Fallenius	Mech	JF/HAL	04/2006		
Monika Fällman	Mech/FLA	FB/DS	04/2003		
Olof Grundestam	Mech	AJ/SW	09/2001	02/2004	03/2006
Johannes Gåstam	KIMAB	AE	07/2003	05/2006	
Sofia Heintz	Mech	AE/EG	07/2002	05/2006	
Fredrik Hellström	GM/PT	LF	09/2005		
Astrid Herbst	Mech	DH	03/2001	04/2004	06/2006
Jerome Hoepffner	Mech	DH	09/2001	09/2004	05/2006
Marko Hyensjö	Metso	AD	09/2001	04/2005	
Thomas Hällqvist	Scania	LF	06/2000	05/2003	03/2006
Nulifer Ipek	Mech/FLA	MV	11/1997	03/2002	01/2006
Stefan Ivanell	Mech/HGO	DH	10/2003	05/2005	
Mattias Janson Gärdsback	Mech	AE/GT	03/2004		
Manindra Kaphle	Mech	AE	01/2005		
Natalia Kosterina	Mech	AE	11/2006		
Yuan Lin	Mech	GA	01/2004	06/2006	
Darja Ljubimova	Mech	AE	11/2002	12/2005	
Ola Lögdberg	Scania	HAL/JF	09/2003	10/2006	
Linus Marstorp	Mech	AJ/GB	02/2004	04/2006	
Davide Medici	Mech	HAL	01/2001	03/2004	04/2006
Niklas Mellgren	Mech/FLA	MV	05/2003		
Gustaf Mårtensson	Mech/FLA	AJ	05/1999	02/2004	05/2006
Filli Nurhussen	Mech	AE	03/2002		
Robert Pettersson	Mech	AE	09/2006		
Lars-Uve Schrader	Mech	DH	04/2006		
Tobias Strömgren	Mech	GA/AJ	04/2005		
Anna Svärd	GM/PT	HAL/NT	09/2005		
Outi Tammisola	Mech	DS/FL	06/2006		
Michael Thomas	Mech	HAL/JF	08/2005		
Olle Törnblom	Mech	AJ	01/2000	01/2003	09/2006
Carl-Gustav Unckel	Mech	DH	10/2004		
Walter Villanueva	Mech	GA	02/2003		
Espen Åkervik	Mech	DH	03/2004		
Ramis Örlü	Mech	HAL/NT	02/2004	10/2006	

3 Economy

The financial state of the department is summarized i the diagrams shown below.

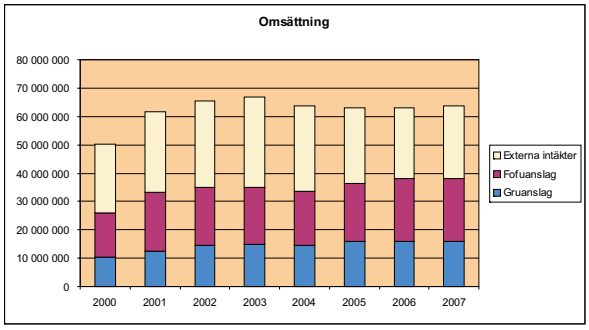

Figure 1: Turnaround during 2000–2007 (projected)

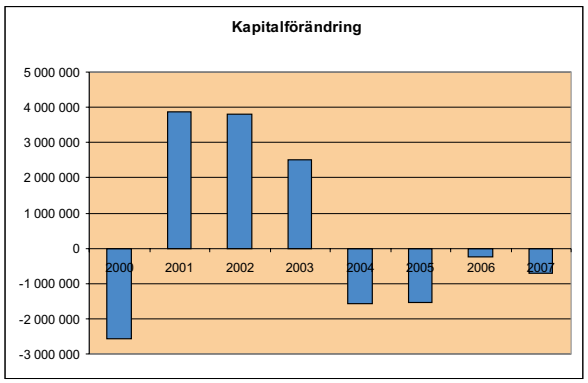

Figure 2: The surplus/deficit during 2000–2007 (projected)

KTH Mekanik

RESULTATRÄKNING 2006 (kr/vh)	GRU	FOFU	Totalt
Gruanslag	15 541 359	0	15 541 359
Fofuanslag	0	22 231 335	22 231 335
Bidrag fr externa finansiärer	0	22 703 660	22 703 660
Övriga intäkter	242 543	2 002 645	2 245 188
Finansiella intäkter	0	284 822	284 822
SUMMA INTÄKTER	*15 783 902*	*47 222 462*	*63 006 364*
Personalkostnader	11 594 105	27 313 393	38 907 498
Lokalkostnader	2 285 893	5 811 210	8 097 103
Resor och traktamenten	738 179	1 275 871	2 014 050
Drift och övrigt	434 984	2 156 863	2 591 847
Gemensamma kostnader	1 966 070	7 867 375	9 833 445
Avskrivningar	20 045	1 728 646	1 748 691
Finansiella kostnader	68 015	6 293	74 308
SUMMA KOSTNADER	*17 107 291*	*46 159 651*	*63 266 942*
ÅRETS KAPITALFÖRÄNDRING	-1 323 389	1 062 811	-260 578

Figure 3: Financial result during 2006

4 Teaching activities

4.1 Undergraduate courses

Program	Year	Course code	Credit	Name	Responsible
Basic courses mechanics					
K, Bio	1	5C1102	4	Mechanics, Smaller course	Lindborg
OPEN	1	5C1102	4	Mechanics, Smaller course	Lundell
F	1	5C1103	6	Mechanics, Basic course	Apazidis
I	1	5C1103	6	Mechanics, Basic course	Essén
ME	1	5C1106	4	Tillämpad fysik, mekanik	G. Karlsson
S	2	5C1107	5	Mechanics	Thylwe
F	2	5C1113	4	Mechanics, Continuation course	Apazidis
BD	1	5C1130	6	Mechanics I	Essén
M	1	5C1130	6	Mechanics I	Nyberg
T	1	5C1130	6	Mechanics I	Nyberg
P	1	5C1130	6	Mechanics I	Bark
M	2	5C1140	4	Mechanics II	Thylwe
T	2	5C1140	4	Mechanics II	Nyberg
P	2	5C1130	6	Mechanics II	Thor
Advanced courses					
All	4	5C1122	4	Continuum mechanics	Söderholm
All	4	5C1123	4	Math. methods of mechanics	Söderholm
All	3	5C1150	5	Advanced engineering mechanics	Essén
All	4	5C1151	5	Multibody dynamics	Thylwe
All	4	5C1400	5	Nonlinear dynamics	Nordmark
Advanced courses structural mechanics					
S	3	5C1810	5	Byggnadsmekanik, grundkurs	Battini
S	4	5C1820	5	Membranes, plates and FEM	Tibert
All	3	5C1830	5	Numerical modelling and simulation	Eriksson
All	2	5C1850	5	Finite element methods	Eriksson
All	2	5C1860	5	Finite element method modelling	Eriksson
Basic courses fluid mechanics					
T	2	5C1216	4	Thermodynamics	Burden
T	2	5C1217	4	Fluid mechanics	A. Karlsson
F	3	5C1202	5	Fluid mechanics, Introductory course	Bark
M	3	5C1220	4	Fluid mechanics for engineers	A. Karlsson
Advanced courses fluid mechanics					
All	4	5C1211	4	Vehicle aerodynamics	Talamelli
All	4	5C1212	5	Computational fluid dynamics	Henningson
All	4	5C1213	2	Applied computational fluid dynamics	Wallin
All	3	5C1214	5	Fluid mechanics, General course	Henningson
All	4	5C1215	5	Compressible flow	Alfredsson
All	4	5C1218	5	Turbulence	Burden
All	4	5C1212	5	Advanced compressible flow	HAL, NA, AD, NT

The number of students based on hås/håp: 8*(hås+håp)/2 during the years 2002-2006 is summarized in the following table

Number of students during 2002-2006					
Students	2002	2003	2004	2005	2006
Basic mechanics	1744	1496	1504	1442	1371
Upper level mechanics courses	48	72	96	52	48
Fluid mechanics	288	408	352	514	425
Structural mechanics	372	317	262	183	146

4.2 Master's thesis projects

Master's theses during 2006		
Name	Title	Advisor
Andersson, Christian	Force on a classical hydrogen atom in crossed electric and magnetic fields	H. Essén
An, Chen	Numerical simulation of a rigid solid particle sedimenting in a liquid	G. Amberg
Barri, Mustafa	Optimal control of bypass transition in boundary layers	L. Brandt
Bellani, Gabriele Benini, Enrico	Design and evaluation of a novel apparatus for sedimentation studies	F. Lundell
Bodin, Olle	Modellering av värmetransport i strömningsmekaniska beräkningar	S. Wallin
Bruhn, Tomas	Dynamic high-pass filtered subgrid-scale models for LES	P. Schlatter
Catrin, Sven	Process of characterization of heat & exchangers process of collection and analysis tests from vapour cycle systems	S. Wallin
Delvecchio, Marco	Experimental analysis of the development of turbulence in a plane Contraction	H. Alfredsson
Diaz, Antonio	A Sensivity Analysis of combustion parameters	A. Burden
El Khoury, George	Receptivity of an infinitely thin flat plate to free-stream Vorticity	L. Brandt

Djup, Fredrik	An experimental study of compressible pipe flow	H. Alfredsson
Ekman, Anders	Dynamiska robotberäkningar - i en grafisk MATLAB-Miljö	H. Essén
Eriksson, Christian	Numerisk simulering av roterande tvåfasströmning	A. Dahlkild
Grip, Rasmus	FEM based simulation of single point turning - effects of material flow stress and tool wear on tool temperature	A. Eriksson
Hedlund, Erik	Surface accuracy analysis of axisymmetric inflatable reflector antennas	G. Tibert
Hejdesten, Mattias	An aerodynamic and esthetic design study of a future Volvo sports wagon	A. Talamelli
Hellström, Georg	Spin coating of Blu-ray discs - an experimental study	F. Lundell
Hägg, Martin Lindström, Mathias	Consistent mass matrices for thin triangular shell elements	J-M. Battini
Hormazábal Guerra, Cristóbal	Comparison between direct drive and indirect drive on milling machines with 5-Axes rotary spindle head	H. Essén
Ingeborn, Thomas	Utveckling av mjukvara för visualisering av stela kroppars dynamik	N. Apazidis
Josefsson, Per	Vortex-induced vibration of a variable tension riser	D. Henningson
Juillard, Pierre	Modelling of thermo-hydraulic phenomena resulting from quench occurring in superconducting magnet directly cooled by superfluid helium	H. Alfredsson
Nazarov, Murtazo	Phase field simulations	G. Amberg
Patwari, Anant Rao	Washer fluid flow simulations	S. Wallin
Pettersson, Robert	Investigation of long jumps through motion analysis and numerical simulation	A. Eriksson
Settersjö, Håkan	Modellera och simulera bearbetningsprocessen för spetsning av kopplingskugg	H. Essén

Sköldberg, Daniel	Design of an artificial heart	S. Zahrai
Tammisola, Outi	Spin coating of Blu-ray discs - a numerical study	F. Lundell
Valentini, Gabriele	Stator and rotor interaction in a highly loaded turbine stage	D. Henningson

4.3 Graduate courses

During 2006 the following graduate courses ('forskarutbildningskurser') were given. In addition several reading courses were also given.

- 5C5085 Human movement analysis and simulation (Gutierrez-Farewik)
- 5C5105 Fluid mechanics for graduate students (Lindborg, Brandt, Fransson, Söderholm, Dahlkild)
- 5C5112 Turbulence (Burden)
- 5C1215 Compressible Flow (Alfredsson)
- 5C5113 Advanced compressible flow (Alfredsson, Apazidis, Dahlkild, Tillmark)
- 5C5114 Numerical methods in fluid mechanics (Henningson)
- 5C1221 Wave motions and hydrodynamic stability (Brandt, Fransson)

5 Research activities

5.1 Doctoral theses defended 2006

Nulifer Ipek

Thesis title: Mathematical modelling and experimental studies of the electrolytic pickling of stainless steel
Date: January 27, 2006
Faculty opponent: Prof. Olof Forsén, Helsinki University of Technology
Evaluation committee: Dr Eva Fontes, Catella Generics AB, Prof. Roy Johnsen, NTU, Trondheim, Dr Ruben Wetind, Metso Paper
Main advisor: Docent Michael Vynnycky

Davide Medici

Thesis title: Experimental Studies of Wind Turbine Wakes - Power Optimisation and Meandering
Date: February 10, 2006
Faculty opponent: Prof. Martin Hansen, DTU - Danish Technical University, Copenhagen
Evaluation committee: PhD Patrik Andreasson, Vattenfall AB, Dr. Gunilla Efraimsson, KTH, Dr. Christoffer Norberg, LTU
Main advisor: Prof. Henrik Alfredsson

Thomas Hällqvist

Thesis title: Large Eddy Simulation of Impinging Jets with Heat Transfer
Date: March 3, 2006
Faculty opponent: Prof. Pierre Sagaut, LMM - UPMC/CNRS, Paris
Evaluation committee: Prof. Lars Davidson, Chalmers, Prof. Lennart Löfdahl, CTH, Dr Andreas Borg,Fluid Dynamics Center, VOLVO CARS Corp, Göteborg
Main advisor: Prof. Laszlo Fuchs

Olof Grundestam

Thesis title: Modelling and simulation of turbulence subject to system rotation
Date: March 17, 2006
Faculty opponent: Prof. Sharath Girimaji, TAMU
Evaluation committee: FD, univ.lekt. Martin Berggren, UU, Prof. Lars Davidsson, Chalmers, Prof. Bengt Sundén, LTH
Main advisor: Prof. Arne Johansson

Jerome Hoepffner

Thesis title: Stability and control of shear flows subject to stochastic disturbances
Date: May 5, 2006
Faculty opponent: Prof. John Burns, Virginia Tech
Evaluation committee: FD, univ.lekt. Martin Berggren, UU, Prof. Håkan Gustavsson, LTU, Prof Anders Lindquist, KTH
Main advisor: Prof. Dan Henningson

Gustaf Mårtensson

Thesis title: Analysis of laminar and turbulent flows with turbomachinery, biotechnology and biomechanical applications
Date: May 5, 2006
Faculty opponent: Prof. GertJan van Heijst, Eindhoven University of Technology
Evaluation committee: Prof. Dan Loyd, LiTH, Prof. Håkan Gustavsson, LTU, Dr. Torgny Lagerstedt, Alfa Sweden AB
Main advisor: Prof. Arne Johansson

Carl-Ola Danielsson

Thesis title: Electropermutation Assisted by Ion-Exchange Textile - Removal of Nitrate from Drinking Water
Date: June 8, 2006
Faculty opponent: Prof. Gérald Pourcelly, Université Montpeiller, Montpeiller, France
Evaluation committee: Prof. Gunnel Dalhammar, KTH, Docent Joaquin Martinez, KTH, Prof. Gun Trägårdh, LTH
Main advisor: Docent Anders Dahlkild

Astrid Herbst

Thesis title: Numerical studies of turbulent and separated flows
Date: June 16, 2006
Faculty opponent: Prof. Helge Andersson, NTNU, Trondheim
Evaluation committee: Prof. Hans Kuerten, TU Eindhoven, The Netherlands, Prof. Yvan Maciel, Université Laval, Canada, Univ. lektor Jesper Oppelstrup, KTH,
Main advisor: Prof. Dan Henningson

Olle Törnblom

Thesis title: Experimental and computational studies of turbulent separating internal flows
Date: September 8, 2006
Faculty opponent: Professor Michel Stansilas, École Centrale de Lille
Evaluation committee: Dr. Richard Gebart, LTU, Karin Sjörs, FOI, Prof. Bengt Sundén, LTH
Main advisor: Prof. Arne Johansson

Luca Facciolo

Thesis title: A study on axially rotating pipe and swirling jet flows
Date: March 10, 2006
Faculty opponent: Prof. Helge Andersson, NTNU, Trondheim
Evaluation committee: PhD Jan Eriksson, Vattenfall, Docent Jens Klingmann, LTH, Prof. Mats Sandberg, Högskolan i Gävle
Main advisor: Prof. Henrik Alfredsson

5.2 Licentiate theses presented 2006

Daniel Ahlman

Thesis title: A study of turbulence and scalar mixing in a wall-jet using direct numerical simulation
Date: April 28, 2006
External examiner: Prof. Lars-Erik Eriksson, Volvo Flygmotor AB, Trollhättan
Main advisor: Prof. Arne Johansson

Linus Marstorp

Thesis title: Subgrid-scale modelling for large-eddy simulation invluding scalar mixing in rotating turbulent shear flows
Date: April 28, 2006
External examiner: Prof. Lars-Erik Eriksson, Volvo Flygmotor AB, Trollhättan
Main advisor: Prof. Arne Johansson

Johannes Gårdstam

Thesis title: Simulation of mechanical joining for automotive applications
Date: May 19, 2006
External examiner: Ass. Prof. Kjell Simonsson, LiU
Main advisor: Prof. Anders Eriksson

Sofia Heintz

Thesis title: Muscular Forces from Static Optimization
Date: May 19, 2006
External examiner: Prof. Anton Arndt, KI
Main advisor: Prof. Anders Eriksson

Peter Andrén

Thesis title: Development and results of the Swedish road deflection tester
Date: June 9, 2006
External examiner: Adj. Prof. Anders Lenngren, Chalmers
Main advisor: Prof. Anders Eriksson

Ramis Örlü

Thesis title: Experimental study of passive scalar mixing in swirling jet flows
Date: October 26, 2006
External examiner: Tekn. Dr. Peter Johansson, Chalmers
Main advisor: Prof. Henrik Alfredsson

Ola Lögdberg

Thesis title: Vortex generators and turbulent boundary layer separation control
Date: November 3, 2006
External examiner: Prof. Per-Åge Krogstad, NTNU, Trondheim
Main advisor: Prof. Henrik Alfredsson

5.3 Publications 2006

5.3.1 Publications in archival journals

1 Ahlström A, 2006, Emergency stop simulation using a finite element model developed for large blade deflections., *Wind energy*, **9**, 193-210.

2 Ahlström A, 2006, Influence of wind turbine flexibility on loads and power production., *Wind energy*, **9**, 237-249.

3 Aldaeus F, Lin Y., Amberg G., Roeraade J, 2006, Multi-stepped dielectrophoresis for separation of particles., *J. Chromatography A*, **1131**, 261-266.

4 Barcena T, Shiomi J., Amberg G., 2006, Control of oscillatory thermocapillary convection with local heating, *J. Crystal Growth*, **286**, 502-511.

5 Battini J.M., Pacoste C, 2006, On the choice of the linear element for corotational triangular shells, *Comp Meth Appl Mech Engrg*, **195**, 6362-6377.

6 Birgersson E., Vynnycky M., 2006, A quantitative study of the effect of flow-distributor geometry in the cathode of a PEFC, *J Power Sources*, **153**, 76-88.

7 Carlsson A., Lundell F., Söderberg D., 2006, The wall effect on the orientation of fibres in a shear flow, *Annu Trans Nordic Rheol Soc*, **14**, 83-90.

8 Chevalier M., Hoepffner J.P.J., Bewley T. R., Henningson D.S, 2006, State estimation in wall-bounded flow systems. Part 2. Turbulent flows, *J. Fluid Mech.*, **552**, 167-187.

9 Eliasson V.E., Apazidis N., Tillmark N., Lesser M.B., 2006, Focusing of strong shocks in an annular shock tube, *Shock waves*, **15**, 205-217.

10 Eliasson V.E., Apazidis N., Tillmark N., Lesser M.B., 2006, Shaping converging shock waves by means of obstacles, *J Visualization*, **9**, 240.

11 Eriksson A., Tibert G., 2006, Redundant and force-differentiated systems in engineering and nature, *Comput Methods Appl Mech Engrg*, **195**, 5437-5453.

12 Eriksson A., 2006, Criteria for optimality in movements (contribution to 5th WCB, Munich), *J Biomech*, **39**, S54.

13 Fransson J. H. M., Talamelli A., Brandt L., Cossu C., 2006, Delaying transition to turbulence by a passive mechanism, *Phys Rev Lett*, **96**, 064501.

14 Gurbatov S.N., Demin Yu, Cherepennikov V.V., Enflo B.O., 2006, The nonlinear decay of cylindrical and spherical acoustic random waves, *Modern Prob Stat Phys*, **5**, 5-34.

15 Gutierrez-Farewik E.M., Bartonek A., Saraste H., 2006, Comparison and evaluation of two common methods to measure center of mass displacement in three dimensions during gait, *Human Movement Science*, **25**, 238-256.

16 Hennigson D., Högberg M., Chevalier M., 2006, Optimal feedback control applied to boundary layer flow, *J of turbulence*, **76**, 10.1080.

17 Herbst A., Hennigson D., 2006, The influence of periodic excitation on a turbulent separation bubble, *Flow, turbulence and combustion*, **6**, 1-21.

18 Holmqvist J.F., Dahlkild A. A., Norman B., 2006, A Flexible Approach for Modelling Flow in Multi-Component Blade Formers, *Nordic Pulp and Paper Research J*, **1**,73-81 .

19 Karlsson G, Burden A., Cohen I., Dodd D., 2006, Distance Tutoring in Mechanics, *Int J Emerging Tech in Learning (iJET)*, **1:1**, .

20 Kowalczyk P., di Bernardo M., Champneys A. R., Hogan S. J., Homer M. E., Piiroinen P T, Kuznetsov Yu. A., Nordmark A., 2006, Two-parameter discontinuity-induced bifurcations of limit cycles: classification and open problems, *Int J Bifurcation and Chaos* ., **16**, 601-629.

21 Levin O., Herbst A. H., Henningson D.S, 2006, Early turbulent evolution of the Blasius wall jet, *J. Turbulence*, **7**, 1-17.

22 Lindborg E., 2006, The energy cascade in a strongly stratified fluid, *J. Fluid Mech.*, **550**, 207-242.

23 Medici D., Alfredsson P. H., 2006, Measurements on a wind turbine wake: 3D effects and bluff body vortex shedding, *Wind energy*, **9**, 219-236.

24 Mårtensson G.E., Skote M., Malmqvist M., Falk M., Asp A., Svanvik N., Johansson A.V., 2006, Rapid PCR amplification of DNA utilizing Coriolis effects., *Eur. Biophys. J.*, **35**, 453-458.

25 Nordmark A., Kowalczyk P., 2006, A codimension-two scenario of sliding solutions in grazing-sliding bifurcations, *Nonlinearity*, **19**, 1-26.

26 Schlatter P., Stolz S., Kleiser L., 2006, LES of spatial transition in plane channel flow, *J. Turbulence*, **7**, 1-24.

27 Singer H M, Loginova I., Bilgram J H, Amberg G., 2006, Morphology diagram of thermal dendritic solidification by means of phase-field models in two and three dimensions, *J. Crystal Growth*, **296**, 58-68.

28 Stålberg E., Brüger A., Lötstedt P., Henningson D.S, Johansson A.V., 2006, High order accurate solution of flow past a circular cylinder., *J. Sci. Comput.*, **27**, 431-441.

29 Thylwe K.-E., 2006, Multi-state complex angular momentum residues, *J. Phys. A: Math. Gen.*, **39**, 11895.

30 Thylwe K.-E., Yngve S, Fröman P., 2006, Study of the validity of the phase-integral connection formula for potential barriers of arbitrary thickness, *J. Math. Phys.*, **47**, 073510.

31 Villanueva W, Amberg G., 2006, Some generic capillary-driven flows, *Int. J. Multiphase Flow*, **32**, 1072-1086.

32 Åkervik W., Brandt L., Henningson D.S., Hoepffner J., Marxen O., Schlatter P., 2006, Steady solutions of the Navier-Stokes equations by selective frequency damping, *Phys. Fluids*, **18**, 068102.

5.3.2 Publications in conference proceedings and books

33 Carlsson A., Lundell F., Söderberg D., 2006, Fibre orientation control related to papermaking, *ASME Joint U.S. - European Fluids Engineering Summer Meeting*.

34 Eliasson V.E., 2006, The production of converging polygonal shock waves by means of reflectors and cylindrical obstacles, *AIP Conf Proc*, **832**, 445-449.

35 Enflo B.O., Hedberg C.M., Rudenko O., 2006, Standing waves in quadratic and cubic nonlinear resonators: Q-factor and frequency response, *AIP Conf Proc*, **838**, 457-460.

36 Enflo B.O., Hedberg C.M., Rudenko O., 2006, Standing and propagating waves in cubically nonlinear media, *AIP Conf Proc*, **834**, 187-195.

37 Enflo B.O., Hedberg C.M., Rudenko O., 2006, Wave motion in a medium with a cubic nonlinearity, *Proc. 4th Polyakov Readings, S:t Petersburg 7-10 February 2006*, 65-74.

38 Eriksson A., 2006, Optimization of targeted movements, *Proc. ECCM-2006, Lisbon*, **CD-ROM**.

39 Fransson J. H. M., Brandt L., Talamelli A., Cossu C., 2006, Experimental study of the stabilization of Tollmien-Schlichting waves by finite amplitude streaks, *Laminar-Turbulent Transition, Proc. IUTAM Symp., Bangalore, Dec. 13-17. 2004. Ed. Rama Govindarajan, Springer,*, p. 299-304.

40 Kierkegaard A. K., Efraimsson G, Hoepffner J.P.J., Åkervik E.Å., Henningson D.S, Åbom M. A., 2006, Identification of sources of sound in low mach number flows by the use of flow field eigenmodes, *Proc 13th Int Congress on Sound and Vibrations.*.

41 Schlatter P., Stolz S., Kleiser L., 2006, Applicability of LES models for prediction of transitional flow structures, *Laminar-Turbulent Transition, Proc. IUTAM Symp., Bangalore, Dec. 13-17. 2004. Ed. Rama Govindarajan, Springer*, 323-328.

42 Schlatter P., Stolz S., Kleiser L., 2006, Analysis of the SGS energy budget for deconvolution- and relaxation-based models in channel flow, *Direct and Large-Eddy Simulation VI*, pp. 135-142.

43 Schlatter P., Stolz S., Kleiser L., 2006, Numerical simulation of transition and turbulence in wall-bounded shear flow, *High Performance Computing on Vector Systems*, pp. 77-86.

44 Söderholm L. H., 2006, Nonlinear Acoustics Equations to Third Order. New Stabilization of the Burnett Equations, *Mathematical Modelling of Wave Phenomena*, **2**, 214-221.

5.3.3 Technical reports (TRITA)

45 Ahlman D.A., 2006, A study of turbulence and scalar mixing in a wall-jet using direct numerical simulation, *Licentiate thesis*, KTH/MEK/TR–06/05–SE.

46 Andrén P., 2006, Development and results of the Swedish road deflection tester, *Licentiate thesis*, KTH/MEK/TR–06/13–SE.

47 Danielsson C., 2006, Electropermutation Assisted by Ion-Exchange Textile - Removal of Nitrate from Drinking Water, *Doctoral thesis*, KTH/MEK/TR–06/10–SE.

48 Facciolo L, 2006, A study on axially rotating pipe and swirling jet flows, *Doctoral thesis*, KTH/MEK/TR–06/02–SE.

49 Gårdstam J, 2006, Simulation of mechanical joining for automotive applications, *Licentiate thesis*, KTH/MEK/TR–06/03–SE.

50 Grundestam O.G., 2006, Modelling and simulation of turbulence subject to system rotation, *Doctoral thesis*, KTH/MEK/TR–06/04–SE.

51 Hällqvist T., 2006, Large Eddy Simulation of Impinging Jets with Heat Transfer, *Doctoral thesis*, KTH/MEK/TR–06/01–SE.

52 Heintz S, 2006, Muscular Forces from Static Optimization, *Licentiate thesis*, KTH/MEK/TR–06/09–SE.

53 Herbst A. H., 2006, Numerical studies of turbulent and separated flows, *Doctoral thesis*, KTH/MEK/TR–06/12–SE.

54 Hoepffner J.P.J., 2006, Stability and control of shear flows subject to stochastic disturbances, *Doctoral thesis*, KTH/MEK/TR–06/08–SE.

55 Lin Y., 2006, Numercial modeling of dielectrophoresis, *Licentiate thesis*, KTH/MEK/TR–06/14–SE.

56 Lögdberg O., 2006, Vortex generators and turbulent boundary layer separation control, *Licentiate thesis*, KTH/MEK/TR–06/16–SE.

57 Marstorp L..M., 2006, Subgrid-scale modelling for large-eddy simulation invluding scalar mixing in rotating turbulent shear flows, *Licentiate thesis*, KTH/MEK/TR–06/07–SE.

58 Mårtensson G.E., 2006, Analysis of laminar and turbulent flows with turbomachinery, biotechnology and biomechanical applications, *Doctoral thesis*, KTH/MEK/TR–06/06–SE.

59 Örlü R.Ö., 2006, Experimental study of passive scalar mixing in swirling jet flows, *Licentiate thesis*, KTH/MEK/TR–06/11–SE.

60 Törnblom O., 2006, Experimental and computational studies of turbulent separating internal flows, *Doctoral thesis*, KTH/MEK/TR–06/15–SE.

5.4 Seminars

Seminars given at KTH Mechanics (The Licentiate and Doctoral defences are not included)

January 26 Carl Erik Wasberg, FFI, Norway
Application of a spectral element method in turbulence simulation.

January 27 Olof Forsén, Helsinki University of Technology
Evaluation of the electrochemical activity of a permanent anode.

January 31 Bengt Enflo, KTH, Mekanik
Propagating and standing waves in cubically nonlinear media.

February 23 Tom Mullin, Director of Manchester Center for Nonlinear Dynamics
Transition experiments in pipe flow.

March 2 Olof Grundestam, KTH, Mekanik
DNS of channel flow with rotation.

March 2 Pierre Sagaut, LMM - UPMC/CNRS, Paris
Variational Multiscale Method for compressible flows: some observations.

March 3 Christian Eriksson, Mekanik
Numerisk beräkning av roterande två-fasströmning.

March 16 Sharath Girimaji, TAMU
Partially Averaged Navier-Stokes (PANS) Approach for Turbulence Simulations; A RANS to DNS Bridging Method.

March 30 Andreas Strub, KTH Mech
Roughness induced transition in hypersonic boundary layer flows.

April 6 Johan Hoffman, KTH NADA
Adaptive computational methods for turbulent incompresible flow.

April 12 Giuseppe Bonfigli, ETH Zürich, Switzerland
Secondary instability in crossflow dominated boundary layers.

April 20 Astrid Herbst, KTH, Mekanik
LES of plane asymmetric diffuser flow.

May 4 John Burns, Virginia Tech
Hybrid Sensitivity Methods for Gradient Based Optimization With Applications to Aerodynamic Design Problems.

May 11 Fredrik Lundell, KTH, Mekanik
Visualization of boiling in small channels by neutron scattering.

May 18 Allan Carlsson, KTH Mekanik
The wall effect on the orientation of fibres in a shear flow.

May 19 Luciano Mariella, Ferrari GS
The role of CFD in the aerodynamic design of a Ferrari Formula 1 car.

May 23 Katarina Gustavsson, KTH NADA
Numerical Simulation of Rigid Fiber Suspension.

June 7 Yuan Lin, KTH, Mekanik
Numerical modeling of dielectrophoresis.

June 15 Dominik Obrist, ETH Zürich, Switzerland
Particle Flow in Semicircular Canals.

June 16 Hans Kuerten, Tu Eindhoven, The Netherlands
Numerical simulation of particle-laden channel flow.

June 19 Fredrik Lundell, KTH, Mekanik
Thermal boundary conductance between carbon nanotubes and surrounding materials by molecular dynamics simulations.

August 21 Tomas Bruhn, KTH
Dynamic high-pass filtered subgrid-scale models for LES.

September 21 Paul Neitzel, Georgia Institute of Technology
Permanent Noncoalescence and Nonwetting: Science and Applications.

October 12 Geert Brethouwer, KTH, Mekanik
Stratified turbulence.

October 19 Rick De Lange, TU Eindhoven
Experimental studies of a jet in cross flow.

November 3 Per-Åge Krogstad, NTNU, Trondheim
Response of a boundary layer to a step change in surface roughness.

November 16 Anjaneyulu Krothapalli, Florida State University
Supersonic Jet noise and its mitigation using microjet injection.

November 23 Pierre Juillard, KTH Mechanics
Modelling of thermo-hydraulic phenomena resulting from quench occurring in superconducting magnet directly cooled by superfluid helium.

November 30 Anjaneyulu Krothapalli, Florida State University
Free and Confined Pulsed Jets.

December 12 Daniel Söderberg, KTH Mechanics
From fibres to paper - a journey through a multiphase state space. Docent lecture

December 12 Hanno Essén, KTH, Mekanik
Magnetic interaction energy in the Lagrangian and Hamiltonian formalisms and its implications.

December 21 Jens H. M. Fransson, KTH, Mechanics
Roughness- good or evil. Docent lecture