Linné Flow Center at KTH

Linné FLOW Centre

Dan Henningson, Director

KTH in numbers

- Education
  - 14 Engineering and one Architecture program
  - 52 Masters programs
  - 12 000 undergraduate students
  - 1 500 PhD students
- Research
  - 14 center of excellence
  - 750 Mkr internal funding
  - 1 200 Mkr external funding
- Staff
  - 3 700 employees
  - 270 professors, 200 associate professors

Linné FLOW Centre

School of Engineering Science (SCI)

- Seven Departments
  - Three physics depts., Mathematics, Mechancis, Aeronautical and Vehicle Eng., Solid Mechanics
- Two Engineering Programs
  - Engineering Physics, and Vehicle Engineering
- Seven Masters Programs
  - Aerospace, Engineering Mech., Mathematics, Sound & Vibration, three Physics programs
- Turnover
  - 500Mkr of which 200Mkr external funding
- Students and Staff
  - 2 000 undergraduate, 200 PhDs, 48 professors

KTH VETENSKAP OCH KONST

Linné FLOW Centre

Participants from FLOW

- Gustav Amberg, *Dean of School of Engineering Science*
  - *Micro and Complex flows*
- Dan Henningson, *Director*
  - *Introduction to Linné FLOW Centre*
- Jens Fransson, *Co-director*
  - *Transition to Turbulence*
- Luca Brandt, *Director of study FLOW graduate school*
  - *Control and Optimization*
- Philipp Schlatter, *Director of Study KCSE graduate school*
  - *Turbulence and Geophysical Flows*
- Gunilla Efraimsson, *Member Management Group*
  - *Aeroacoustics*

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Linné FLOW Centre

Application for Center of Excellence 2006

Linné FLOW Centre







Linné FLOW Centre

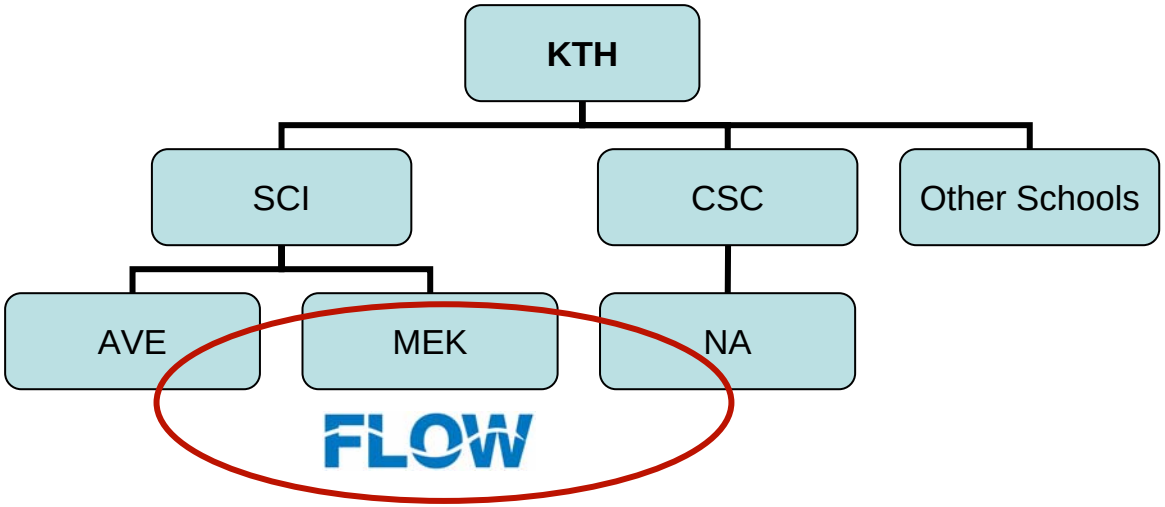
Linné FLOW Centre

- **Vision**

"FLOW as an outstanding environment for fundamental research in fluid mechanics, where innovative research is born and future research leaders are fostered"

Linné Flow centre at KTH

Linné FLOW Centre



- KTH Mechanics, MWL and NA-group
  - 32 PhDs, 14 junior-, 16 senior researchers
  - 40 MSEK/year of which five from VR

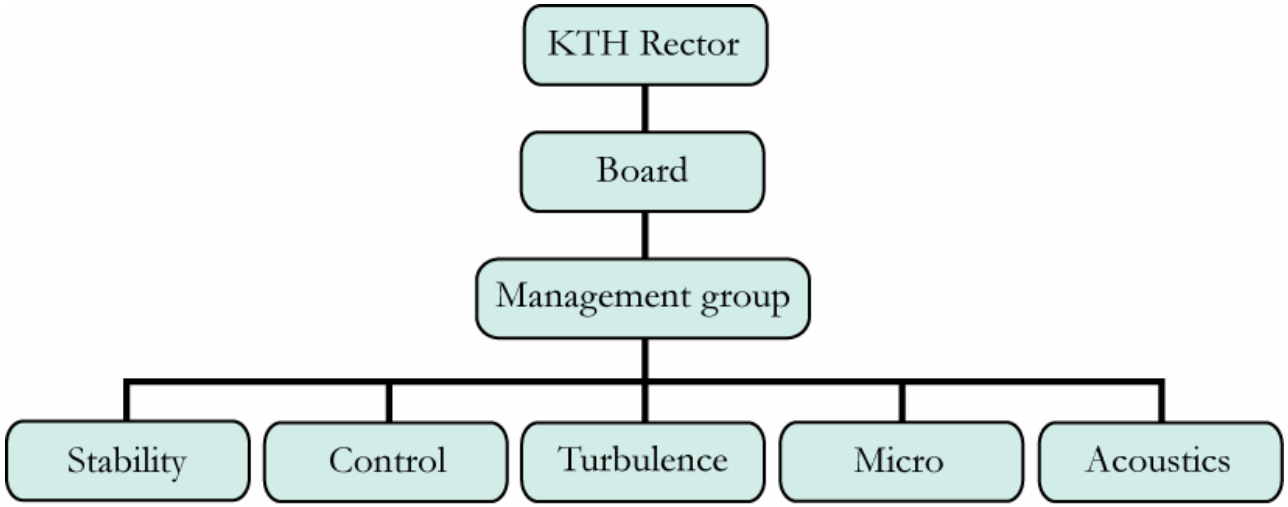
FLOW Goals

- High quality research
- Develop new research areas
- Educate new generations of PhDs
- Foster research leaders
- Catalyze collaborative research at KTH
- National and international visibility
- International cooperation

KTH VETENSKAP OCH KONST

Linné FLOW Centre

Organization of FLOW



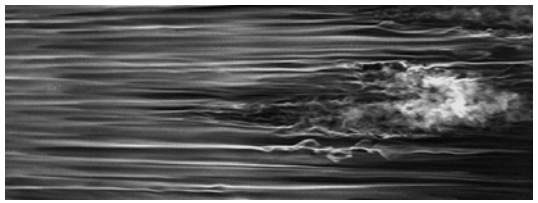
Linné FLOW Centre

- Externa board members
  - Gunnar Landgren, Vicerector, Chairman
  - Birgitta Palmberger, Energimyndigheten
  - Gunnar Svedberg, STFI
  - Erland Källén, MISU
- Management group
  - Dan Henningson, Director
  - Junior researchers

Research areas

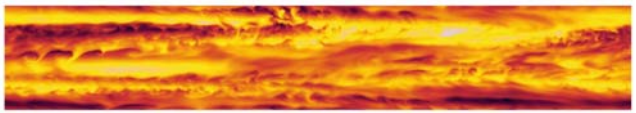
strategies on www.flow.kth.se/research.html

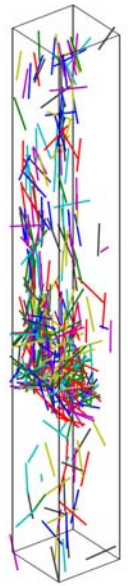
- Stability and transition
  - 6 PhD students



- Flow control and optimization
  - 7 PhD students

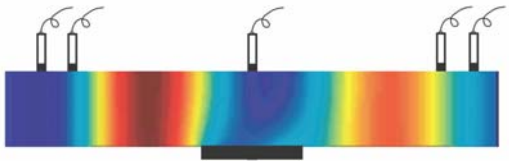
- High Reynolds number turbulence and geophysical flows
  - 6 PhD students





- Micro- and complex fluids
  - 9 PhD students

- Low Mach-number aeroacoustics
  - 4 PhD students



Linné FLOW Centre

Activities

- Research activities
  - PhD/postdoc projects
  - Regular research area meetings
- Graduate school/ summer programs
  - 1500 KSEK/year for FLOW graduate school from VR
  - Short course on turbulence with international lecturers
- Seminars/Linné visitors (2008)
  - 25 visitors
  - 13 PhD students
  - 6 faculty (senior/junior)

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Linné FLOW Centre

Activities

- Workshops/conferences
  - Leadership and career planning activities
  - IUTAM Symposium Laminar-Turbulent Transition June 23-26, 2009

Linné FLOW Centre

- Infrastructure
  - 25 MSEK for "turbulence and climate" computer with MISU, SMHI, called Ekman
  - World class windtunnels and acoustic measurement facilities

- International cooperation
  - Establish China cooperation
  - Experimental turbulence measurement Jamboree

Flow Graduate School

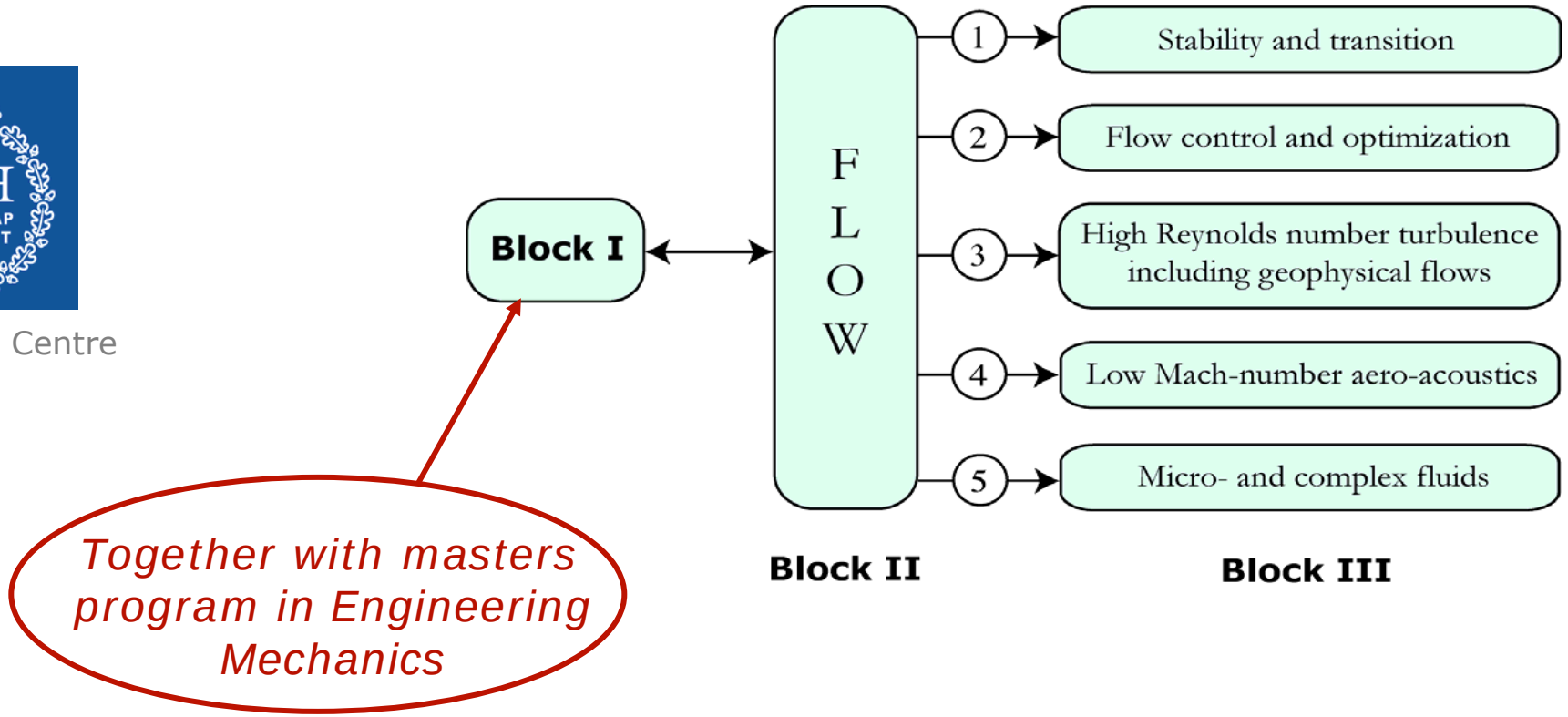
Linné FLOW Centre

- First Swedish Graduate School in Fluid Mechanics
- Widen the competence and perspectives of PhD students in fundamental Fluid Mechanics
- Provide well-organized PhD studies
- National and international exchanges
- Director of studies: Luca Brandt

FLOW Graduate School:

three different categories of courses

Linné FLOW Centre



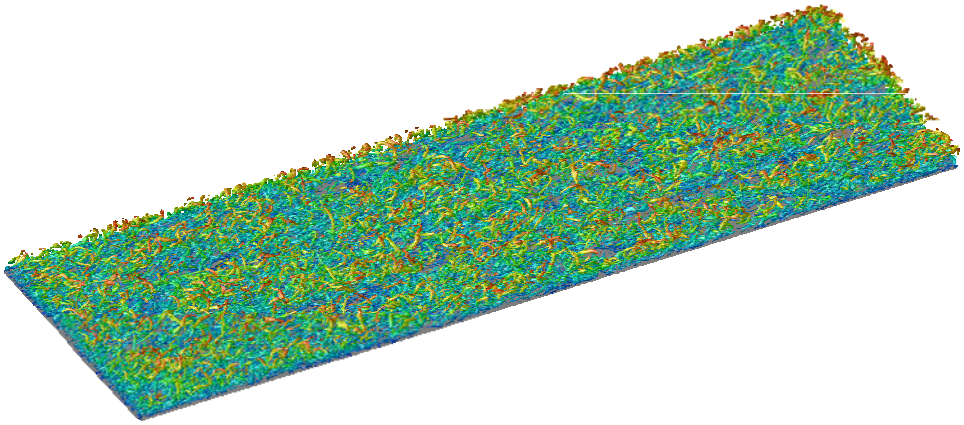
Block III

- Short advanced-level courses, typically summer schools
- Fit with the five priority research areas within FLOW
- 2 courses per year (3-6 ECTS/course)
- Meant to attract international PhD-students
- Upcoming events
  - Summer school on Flow Control 2009, after IUTAM conf.
  - Spring school on Turbulence 2010, with NORDITA program

Linné FLOW Centre

New computer Ekman for large scale numerical experiments

- DNS of turbulent flows in boundary layer and geophysical flows



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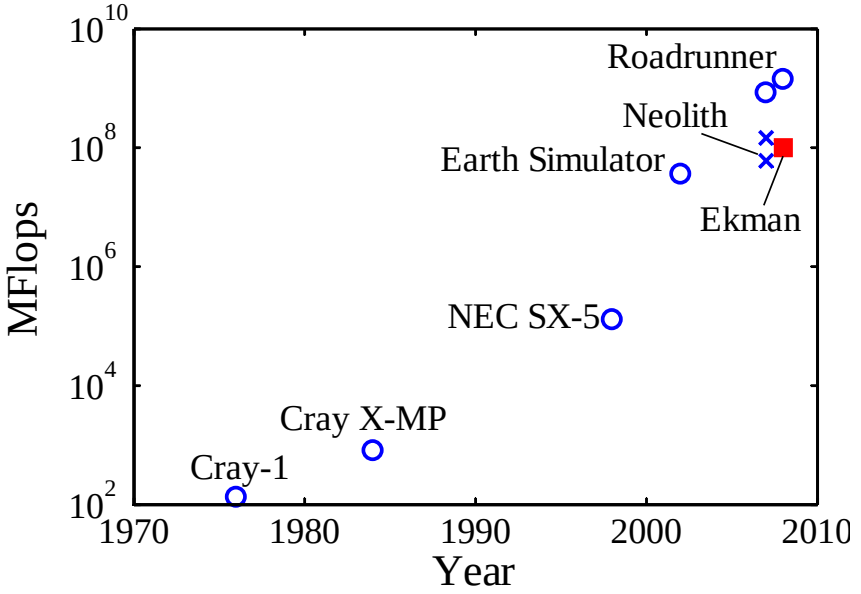
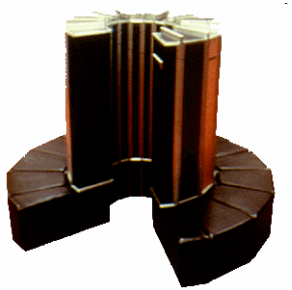
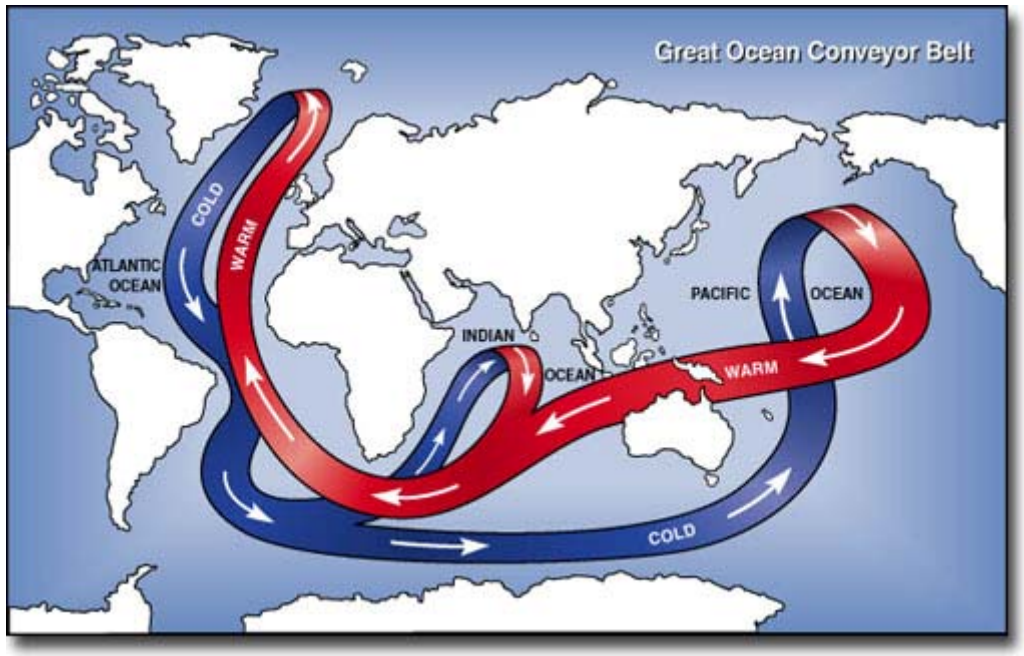


Cray-1 (1976)
100 Mflops
1 processor



Ekman Dell cluster
(2008) 100 Tflops
10000 processors

How will the ocean circulation respond to global warming?



- Ocean large heat regulator of climate
- Great conveyor belt transport warm surface water to north pole and cold water back along bottom
- Circulation affected by turbulent diffusion

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Communication, dissemination and industrial contacts

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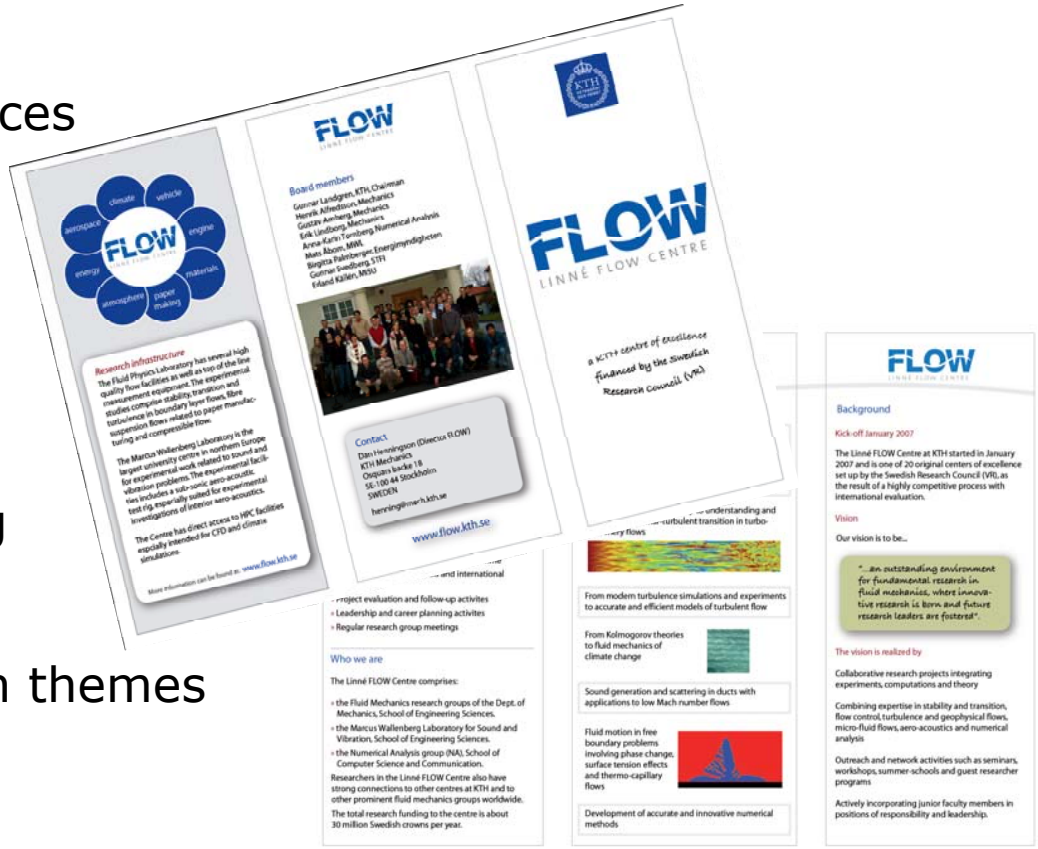
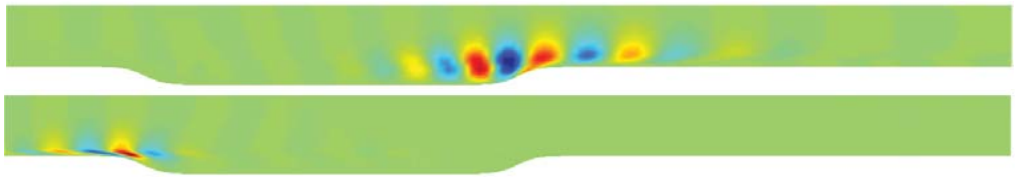
- Publishing and Conferences
- Communication
  - Webpages
  - Brochure
- Short courses enhancing communication skills
- Common communication themes
  - Energy and Climate
- Industrial research projects
  - Airbus, Bombardier
  - Scania, STFI-Packforsk

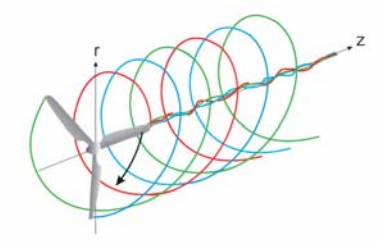


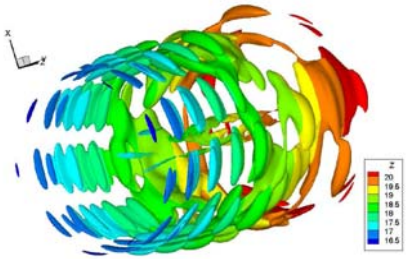
Stability and transition: Jens Fransson

- Non-normality and global modes

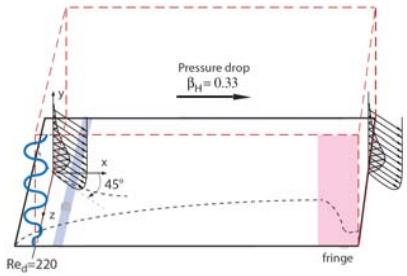


- Wintubine wake instabilities

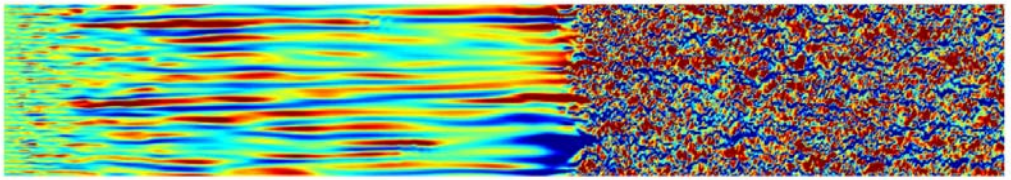




- Receptivity experimets and computation



- Simulation and measurements of bypass transition



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Flow control and optimization: Luca Brandt

- Control of separation using vortex generators
- Feedback control using modern control theory

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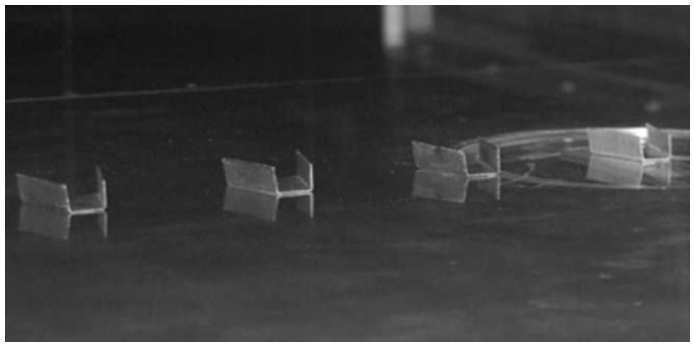
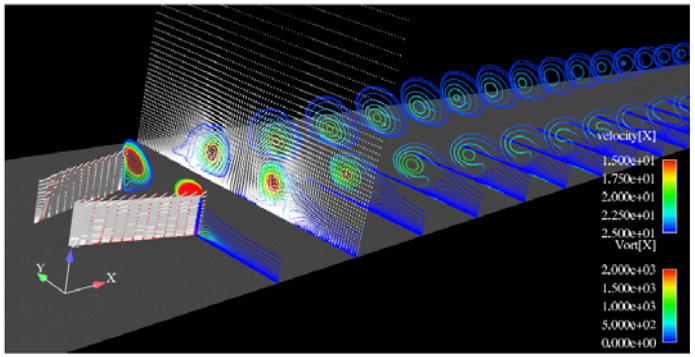
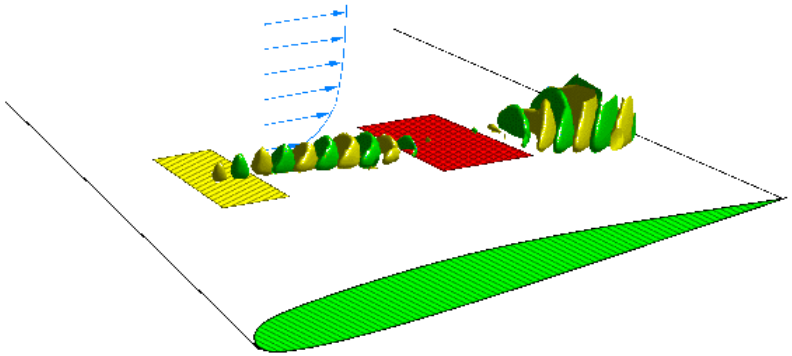
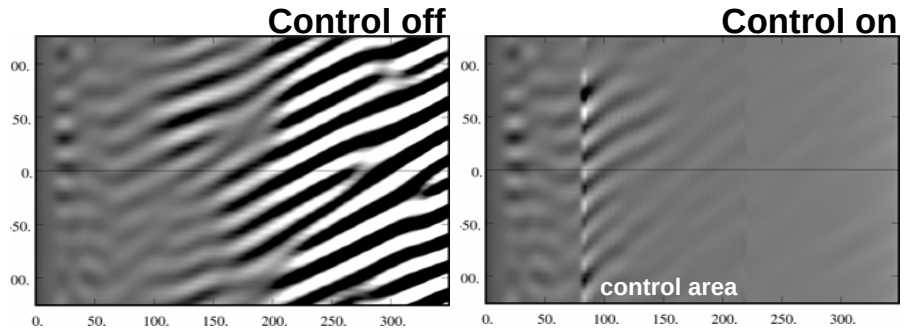


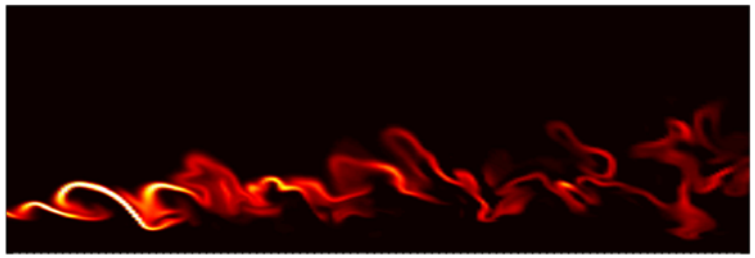






High Reynolds number turbulence and geophysical flows: Philipp Schlatter

- DNS of a combustion in a plane turbulent wall-jet
- Ciclope – high Reynolds number turbulent pipe flow
- 2D turbulence in rotating flow



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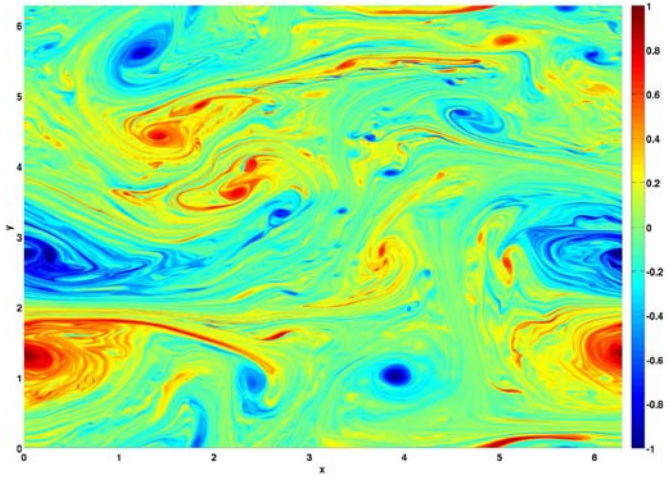

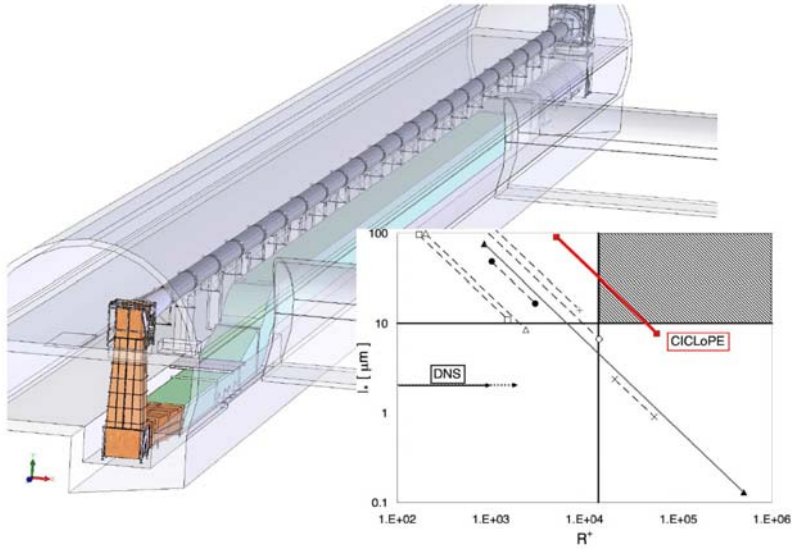

Low Mach-number aeroacoustics: Gunilla Efraimsson

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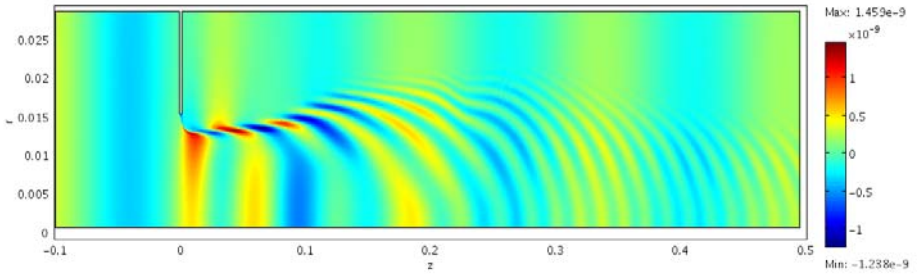
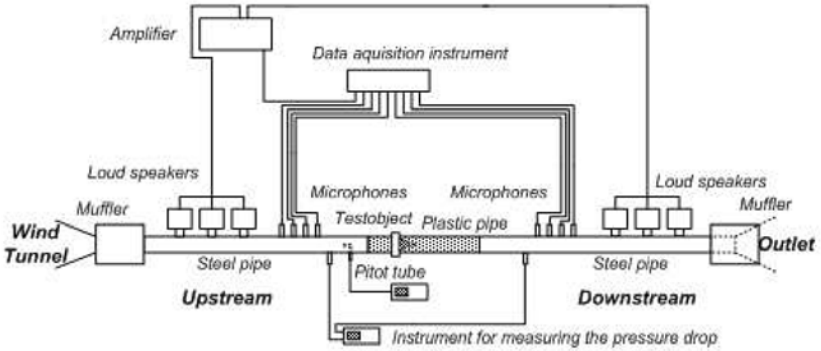
- Computational

  Transmitted sound reflected at a discontinuity where vorticity is created



- Experimental

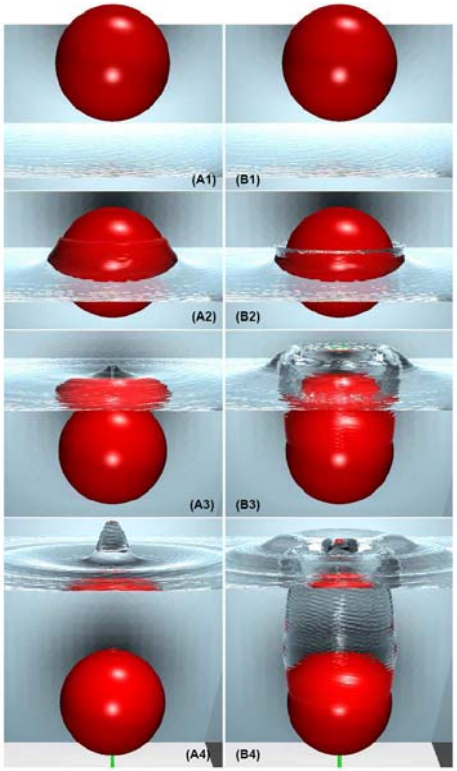
  Direct measurement of scattering matrix allows for accurate determination of reflection and transmission



- Masking of wind turbine noise

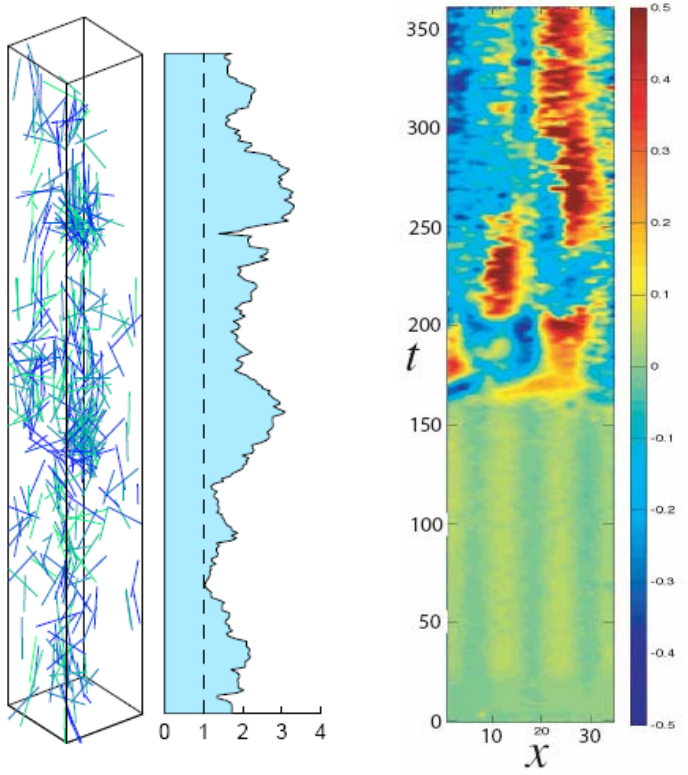
Micro- and complex fluids: Gustav Amberg

- Interface tracking methods for complex flows



Hydrophilic (A) and hydrophobic (B) sphere impacting on a water surface.

- Experiments and simulations of flow with fibres



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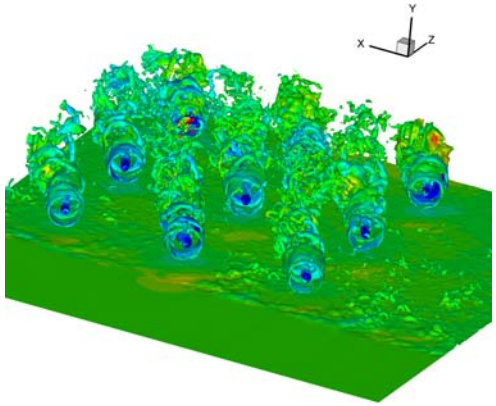
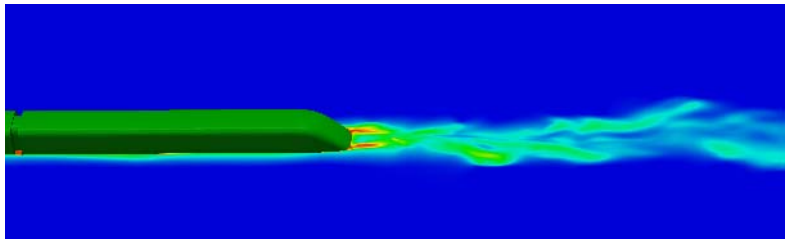
Examples of Applied Fluid Mechanics

- Windfarm simulations



- Vehicle aerodynamics, ex. train slipstream



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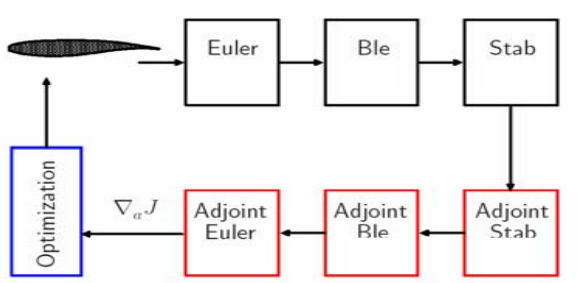
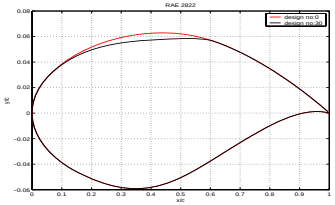
- Natural/Hybrid Laminar Flow Control





FLOW

LINNÉ FLOW CENTRE

- Kick-off/Annual meeting Villa Söderås Jan 2007 and 2008

http://www.flow.kth.se

Possibilities for cooperation

- Reciprocal visit of delegation to KTH
- Linné visitors program at FLOW
- Exchange of PhD students and postdocs
- International participation in FLOW graduate school, possibly through CSC-stipends
- Enrollment of students in Engineering Mechanics masters program

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