

2nd International Symposium on Multi-Scale Experimental Mechanics –

Multi-scale Fatigue

DTU Civil Engineering
Department of Civil Engineering

DTU Mechanical Engineering
Department of Mechanical Engineering

DTU Wind Energy
Department of Wind Energy

CASMaT
Villum Center for Advanced Structural and Material Testing

The research challenge – creating a holistic approach to engineering structures and materials

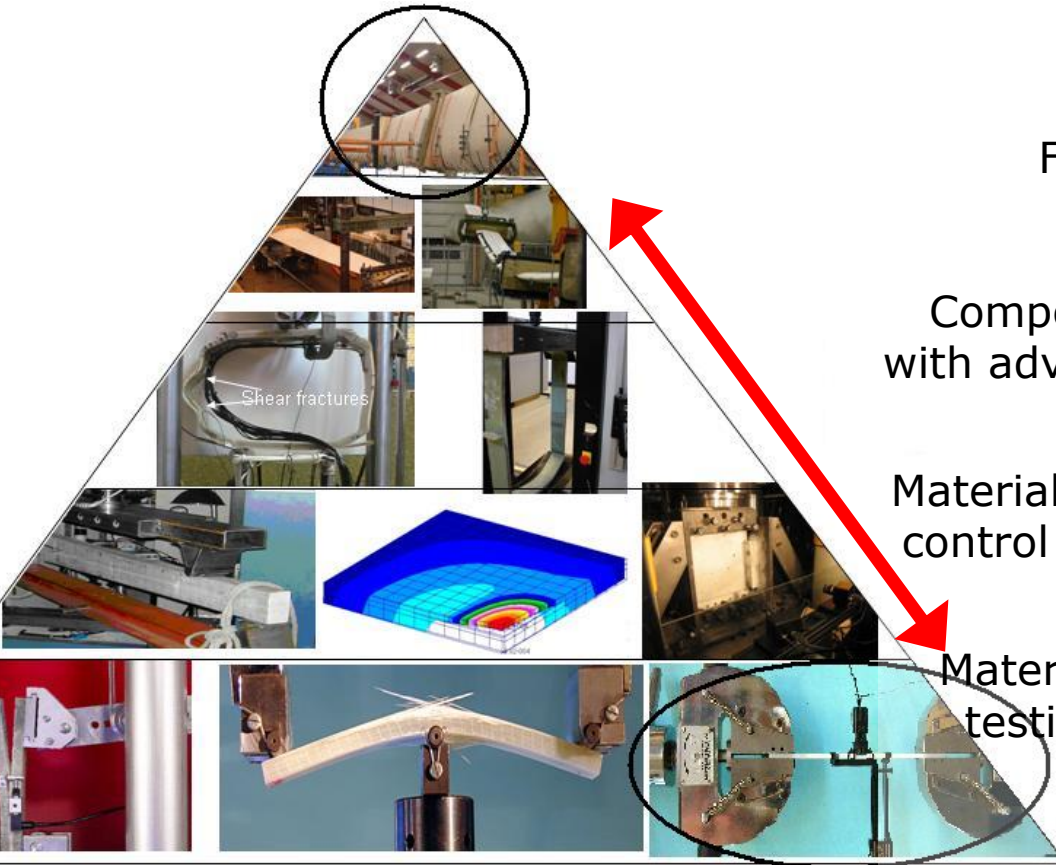
MULTI-SCALE RESEARCH AND ENGINEERING

Full scale: monitoring & modeling

Component or sub-structure: hybrid testing with advanced boundary conditions, control and modeling

Materials and interfaces: testing with advanced control under environmental control combined with modeling

Material structure and composition: micro-testing and -tomography combined with modeling

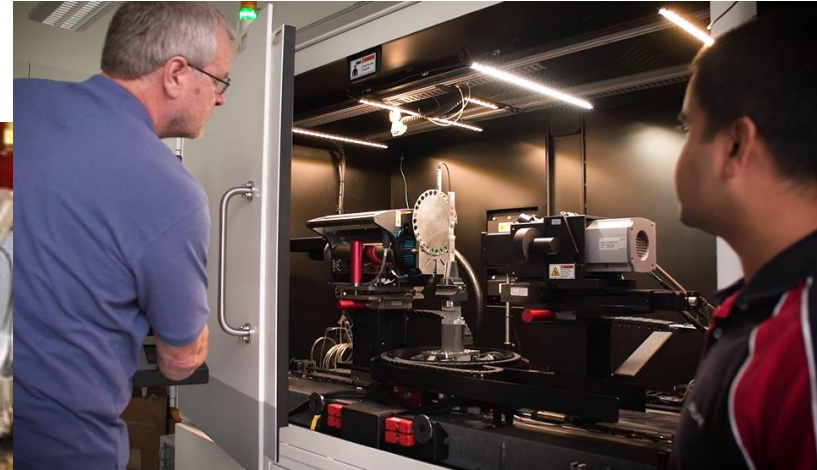


New and powerful modeling techniques require more advanced experimental techniques for verification and new experimental characterization helps develop the fundamental, physical understanding of the governing phenomena

Outline

- Status
- Initiation project
- Symposium program
- Practical remarks

Lab units



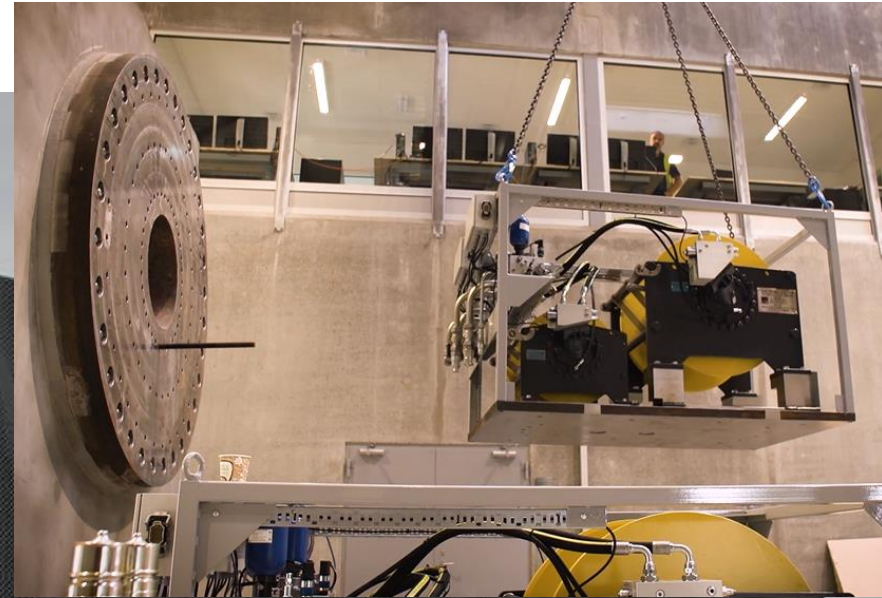
CASMaT
Materials Testing Lab

Lab units



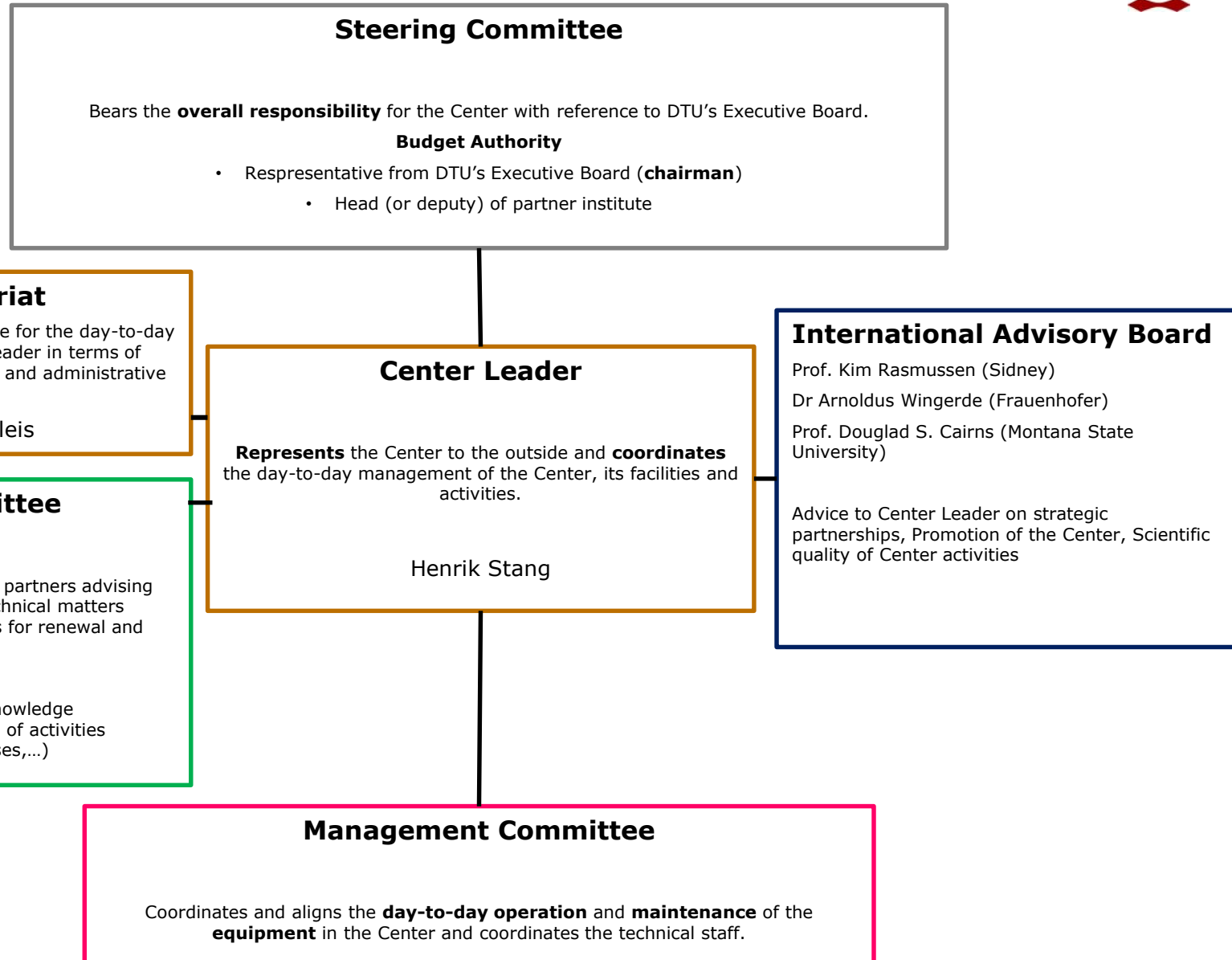
CASMaT
Structural Lab

Lab units



CASMaT
Large Scale Facility

4 Operation of the Center



5 Status International Advisory Board...



Professor Kim Rasmussen, Challis Professor of Civil Engineering and Associate Dean Research of the Faculty of Engineering and IT at the University of Sydney



Professor Douglas S. Cairns, Professor of Mechanical Engineering of the Mechanical & Industrial Engineering Department at Montana State University.



**Dr Arnoldus Wingerde,
Chief scientist Research,
Fraunhofer IWES (Int. Windenergie u. Energ.systemtechnik)**

Visibility: access and search and more

Equipment Registration System

User point of view:

- Search for equipment – seamlessly across lab. units
- Retrieving information about the technical specifications of equipment
- Looking into user manuals and other relevant documentation
- Retrieving information about current bookings of equipment
- Making/requesting and managing own booking
- Retrieving information about the cost associated with use of equipment

Visibility: access and search and more Equipment Registration System

From a lab. technician's point of view additional requirements:

- Maintaining the technical information in the system
- Access to detailed information about the history of the equipment
- Maintaining and retrieving detailed information about the appliances beyond user manuals
- Management of maintenance plans

Visibility: access and search and more

Equipment Registration System

From the lab. managers point of view additional requirements:

- Maintain system user rights
- Review and approve bookings (in a booking workflow)
- Draw reports from the system concerning use by different appliances, by selected projects, by users....
- Maintain price sheets for the appliances
- Preparing data for/sending invoices to customers


Initiation project: Understanding Fatigue Through Multi-scale Testing and Modeling

The motivation to carry out such project is three-fold:

- The project addresses **scientific questions** of high relevance for the scientific community behind CASMaT as well as for society. Further, the scientific questions are directly related to the hypothesis on the relevance multi-scale research and testing, constituting the logic behind CASMaT.
- The project serves to further **expand collaboration and synergies** between the three Departments behind CASMaT.
- The project serves to **enhance the international visibility** of the expertise and technical capabilities of CASMaT

Initiation project

PhD 1: Mechanical characterization of in-plane fatigue damage mechanisms at the micro-scale

A portrait of Ashish Kumar Bangaru, a young man with dark hair and a light beard, wearing a grey polo shirt. He is looking slightly to the right of the camera. The background is a blurred industrial or laboratory setting with some lights.

Ashish Kumar Bangaru

PhD 1 Student, CASMaT Initiation Project

Initiation project

PhD 2: Mechanical characterization of in-plane fatigue damage at the macro-scale

A portrait of Aakash Moncy, a PhD 2 student, wearing glasses and a grey sweater over a checkered shirt. The background is a blurred industrial setting with yellow and black machinery.

Aakash Moncy

PhD 2 Student, CASMaT Initiation Project

Initiation project

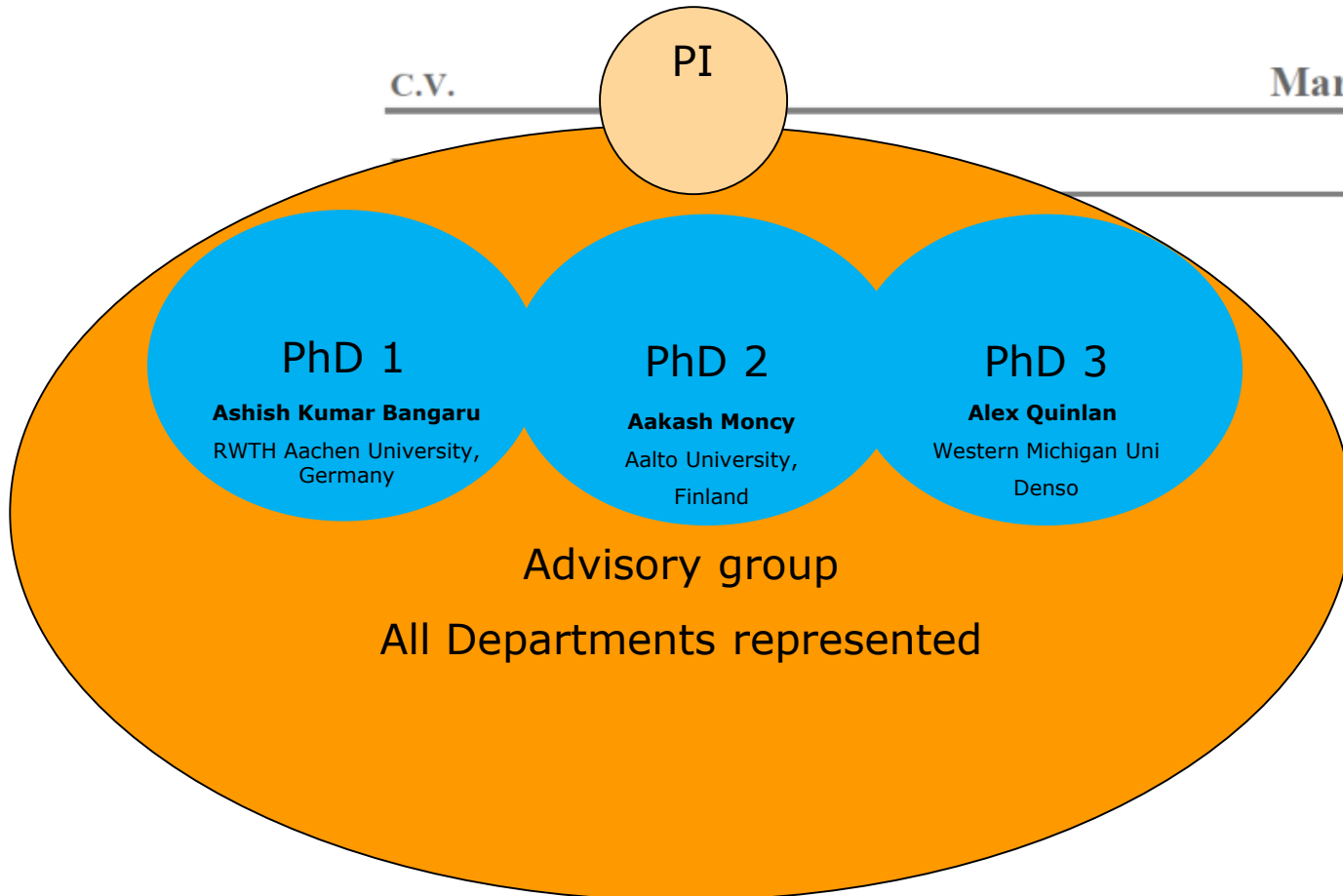


PhD 3: Mechanical characterization of fatigue damage at the structural scale

Alex Quinlan

PhD 3 Student, CASMaT Initiation Project

Initiation project



8 November 2017

8.45 - 9.00 **Welcome and coffee**

9.00 - 9.30 Henrik Stang **CASMaT: The Villum Center for Advanced Structural and Material Testing**

Sub-structure and component Testing, Chair: Bent F. Sørensen

9.30 - 10.00 Arno van Wingerde, Margarita Glöckner **KompZert: a step ahead on the road towards subcomponent testing for rotor blades**

10.00 - 11.30 Arash Farshidi, Søren Bundgaard, Christian Berggreen Ground-Air-Ground (GAG) testing of disbanded honeycomb aircraft sandwich panels

Pietro Sabbadin, Christian Berggreen, Brian Nyvang Legarth Development of a mode I/II/III test fixture for sandwich face/core fracture characterization

Stergios Goutianos, Leonardo Di Crescenzo, Malcolm McGugan, Bent F. Sørensen Specimen design and instrumentation for monitoring fatigue crack growth initiating at ply drops

Vishnu Saseendran, Christian Berggreen On Fracture Testing of Sandwich Face/Core Interface using the DCB-UBM Methodology in Fatigue

Vasileios Karatzas, Mohsen Rezaei, Pierrick Mindykowski, Thomas Hulin, Grunde Jomaas, Christian Berggreen Testing sandwich composites under thermomechanical loading at different scales - a discussion

11.30 - 13.30 **Lunch and Lab visit**

Hybrid and Full Scale Testing, Chair: Henrik Stang

13.30 - 14.00	Shawn S. You, X. Shawn Gao	Hybrid simulation combined with fatigue testing method
14:00 - 15.30	Jacob Paamand Waldbjørn, Christian Berggreen	Single Component Hybrid Simulation on a Wind Turbine Blade
	Alex R. Quinlan	Understanding Fatigue of Fiber Reinforced Polymers through Hybrid Simulation and Multi-scale Testing and Modeling
	Malo Rosemeier, Moritz Bätge, Alexandros Antoniou	A novel single actuator test setup for combined loading of wind turbine rotor blade sub-components
	Kim Branner, Sergey Semenov, Peter Berring, Steen Hjelm Madsen	Full-scale structural testing at DTU Large Scale Facility
	Xiao Chen	Structural degradation of a large composite wind turbine blade in a full-scale fatigue test
18.00	Dinner Brede Spisehus, I.C. Modewegs Vej 40, 2800 Kgs. Lyngby	

9 November 2017

Multi-scale Testing and Modeling Chair: Christian Berggreen

9.00 - 10.00 Ole Thybo Thomsen
Towards a new paradigm for high-fidelity testing and integrated multi-scale modelling of composite substructures and components

Part 1

Janice Dulieu-Barton
Towards a new paradigm for high-fidelity testing and integrated multi-scale modelling of composite substructures and components

Part 2

10.00 - 10.30 **Coffee break**

10.30 - 12.00 Mohsen Rezaei, Mads Borgnæs, Christian Berggreen
Multi-scale testing of composite steel interfaces for blade root bushing connections

Timothy M Harrell, Ole Thybo Thomsen, Janice M. Dulieu-Barton
Hybrid multiscale modelling to predict lightning damage on CFRP materials

Mehrtash Manouchehr, Christian Berggreen, Joachim Holbøll
Experimental study of the effect of high electric voltage on the fatigue life of glass fiber composites

Alexandros Antoniou, Christian Ueing, Catherine Lester, Nils Englisch
A damage approach on the fatigue degradation mechanism of biaxial Glass/Epoxy laminates

12.00 - 13.00 **Lunch**

Test methodologies and modeling Chair: Kim Branner

13.00 - 14.30	Oscar Castro, Paolo Carraro, Lucio Maragoni, Marino Quaresimin	Fatigue damage evolution of unidirectional glass/epoxy composites
	Freja N. Sjøgreen, Stergios Goutianos	Challenges in experimental fatigue testing of glass-fibre reinforced polymer matrix composites for wind turbine industry
	Ulrich Andreas Mortensen	Fatigue damage in non-crimp fabric composites subjected to cyclic bending load
	Ilja Koch, Gordon Just, Maik Gude	Discussions on the influence of residual stresses to the fatigue of layered polymer composites
	Kristine M. Jespersen, Lars P. Mikkelsen	Investigating 3D fatigue damage progression in fibre composites by combining X-ray tomography with trans-illuminated white light imaging
14.30 - 15.00	Coffee break	
15.00 - 16.30	Morten S. Andersen, Christian Ertel	Concrete compression fatigue - Design rules and focus areas for testing
	Jens Peder Ulfkjær	Low Cycle Fatigue of Ultra High Performance Concrete
	Asmus Skar, Peter Noe Poulsen, John Forbes Olesen	Cyclic cohesive model for fatigue crack growth in concrete
	Alexander Michel	Corrosion fatigue - need for further research?
	Rasmus Normann Wilken Eriksen, Christian Berggreen	Blast testing of high strength steel and composite panels - ongoing work

I hope you will enjoy the event!