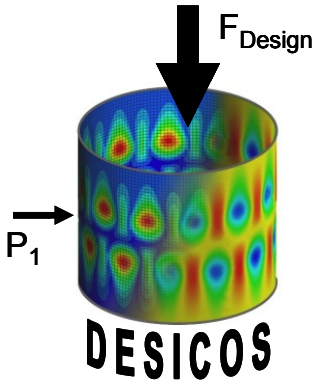
IFAR | INTERNATIONAL FORUM FOR AVIATION RESEARCH



3rd Int. Conference on

Buckling and Postbuckling Behaviour of Composite Laminated Shell Structures

Web conference on

New design concepts for buckling of aerospace composite structures

25 March 2015
Braunschweig, Germany

Richard Degenhardt
German Aerospace Center (DLR), Institute of Composite Structures and Adaptive Systems, Germany

DLR

EU-project DESICOS

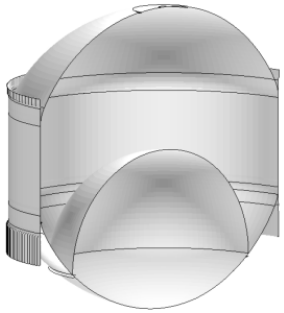
- The web session is part of the
  - 3rd Int. Conf. on Buckling and Postbuckling Behaviour of Composite Laminated Shell Structures

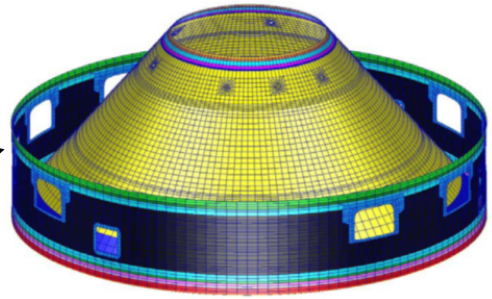
- This conference is a final event of the almost finished EU project DESICOS which stand for
  - New Robust DESIgn Guideline for Imperfection Sensitive COmposite Launcher Structures

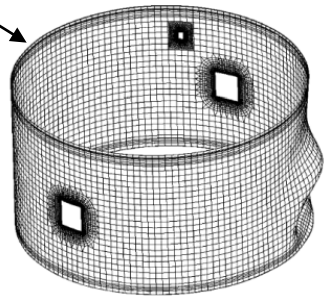
- This session includes presentations from all PhD students from this project

- More details at www.desicos.eu

Structures considered







Ariane 5

Sensitive to imperfections

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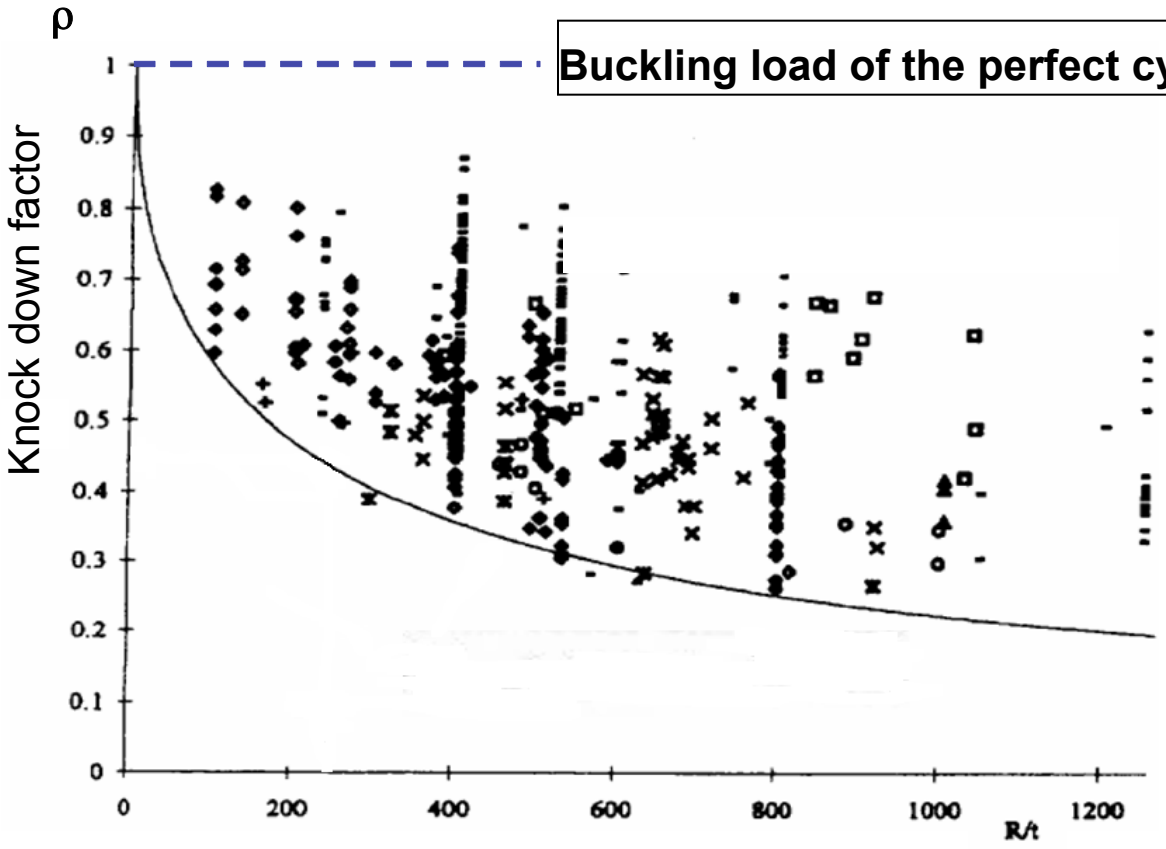
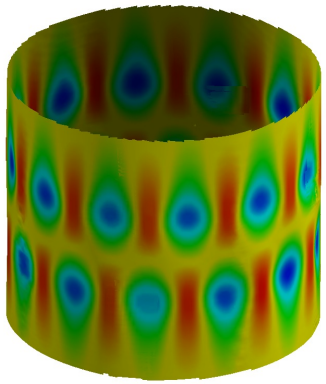
Current design guideline: NASA-SP 8007 (1968)



Buckling load of the perfect cylinder, scaled to 1



Radius / Thickness

- Developed for metallic structures
- No guidelines for composites structures

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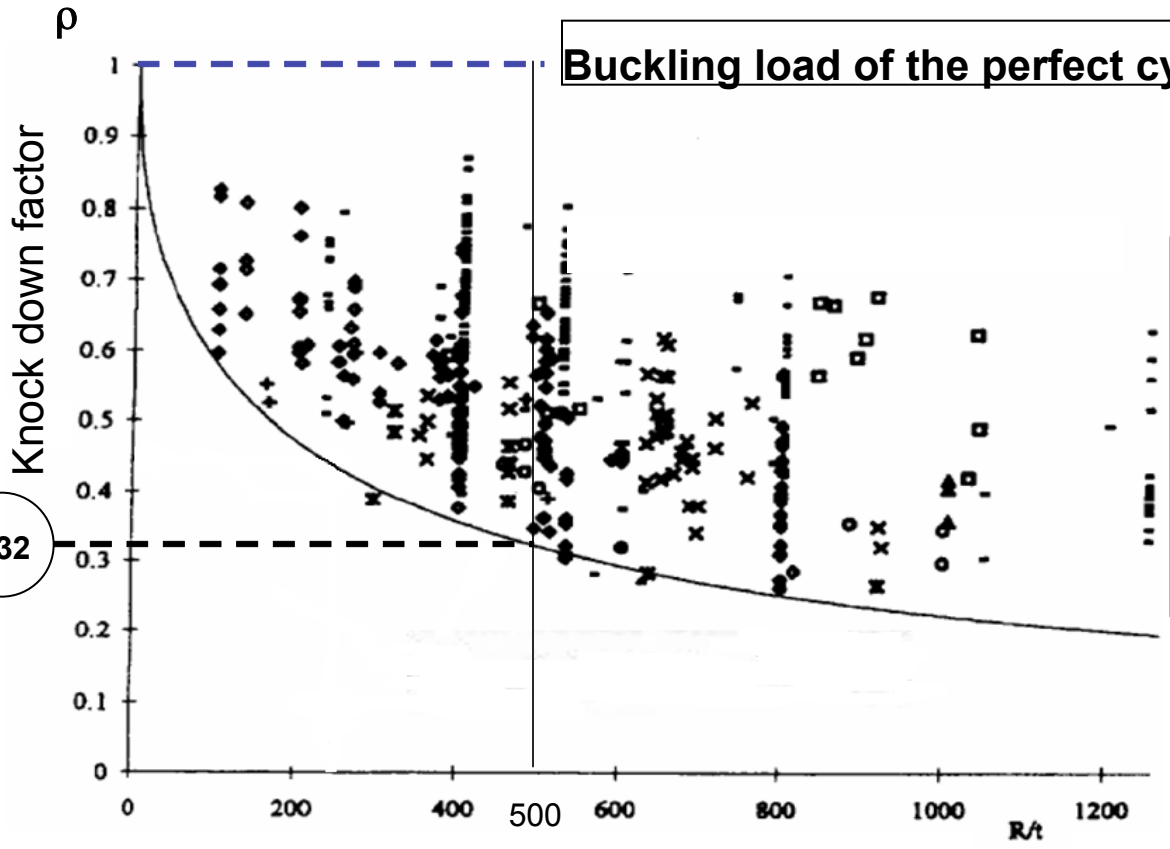
NASA-SP 8007 - Example



Buckling load of the perfect cylinder, scaled to 1

Example: CFRP cylinder
Total length = 540 mm
Free length = 500 mm
Ply orientation = +24,-24,+41,-41
Radius = 250 mm
Thickness = 0.5 mm
R/t = 500
$F_{Perfect}$ = 32 kN

Radius / Thickness

$F_{Design\ load} = F_{Perfect} * r_{NASA}$

$F_{Design\ load} = 32 * 0.32 = \mathbf{10.2\ kN}$

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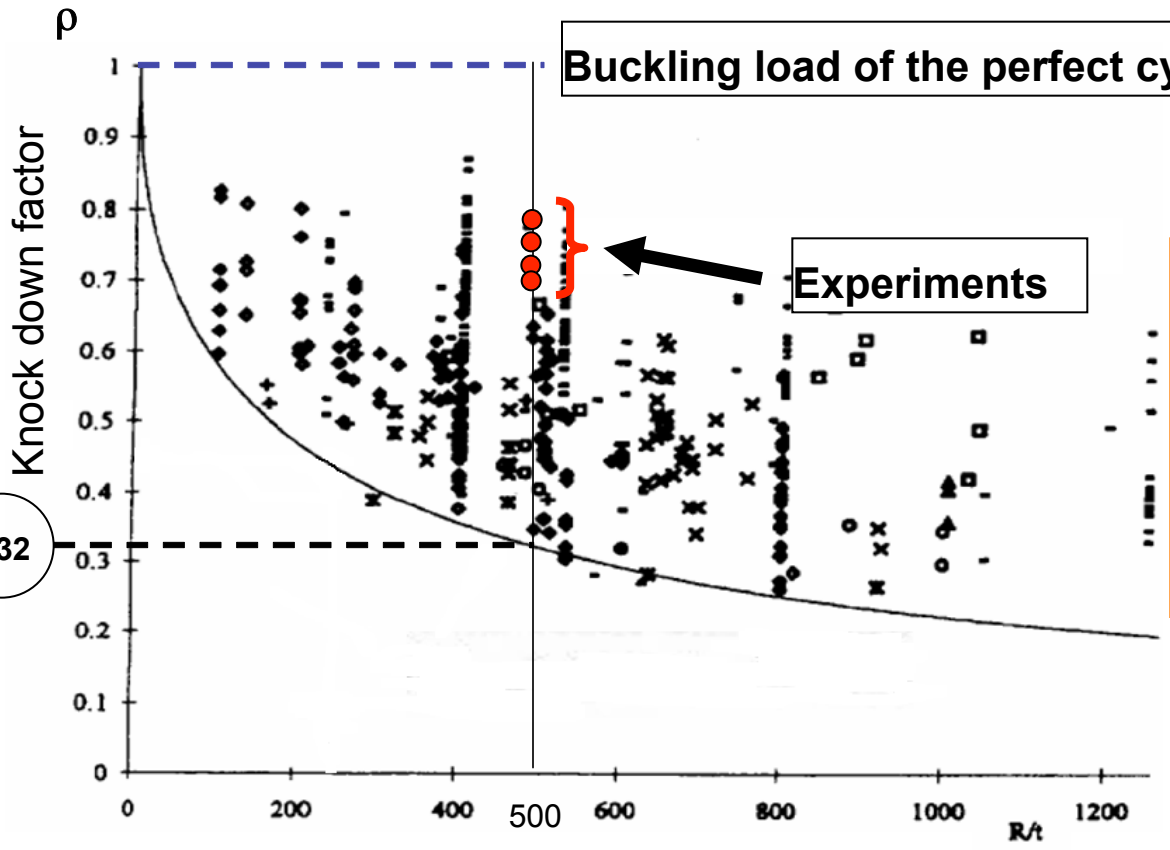
NASA-SP 8007 - Example



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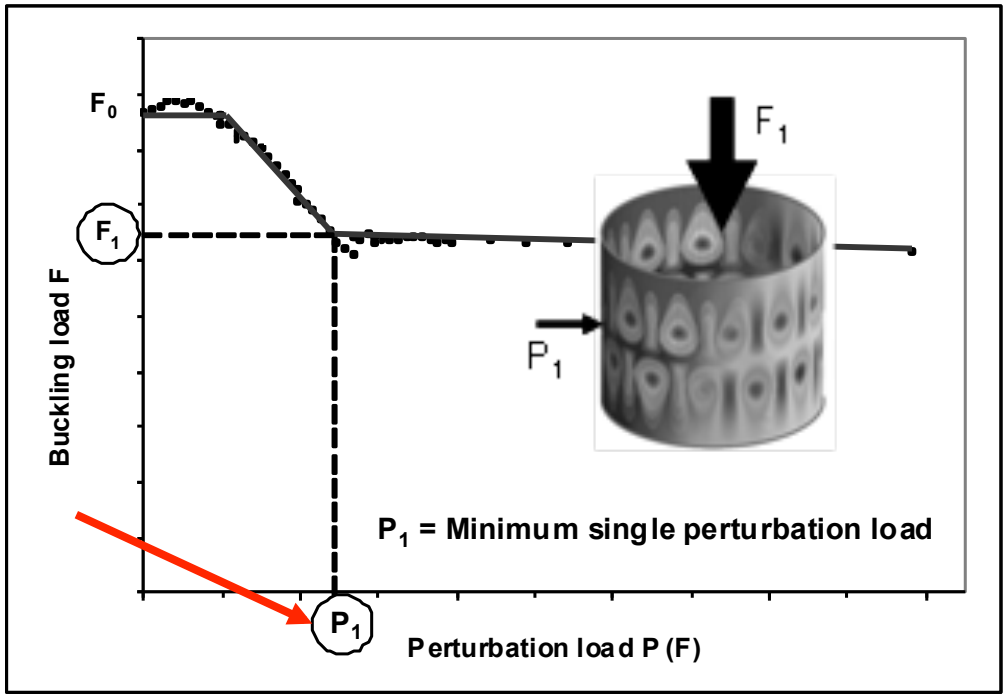
Single Perturbation Load Approach (SPLA)

- **New approach:**
- **Idealization of curve**
- **Lower boundary limit of buckling load for imperfect shells:**
  „Load carrying capability F_1“



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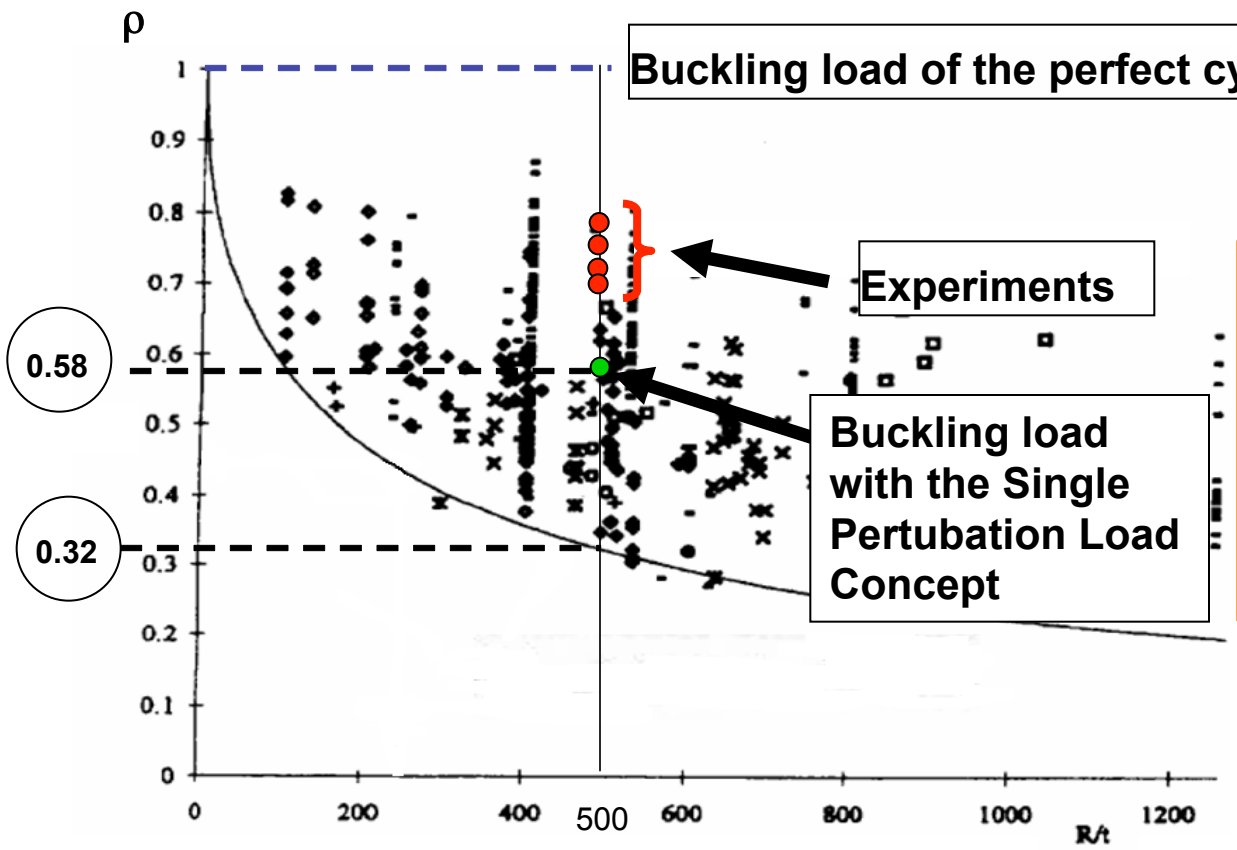
NASA-SP 8007 - Example



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$F_{Design\ load} = 32 * 0.32 = \mathbf{10.2\ kN}$

$F_{Design\ load} = F_{Perfect} * r_{Experiment}$
$F_{Design\ load} = 32 * 0.58 = \mathbf{18.5\ kN}$

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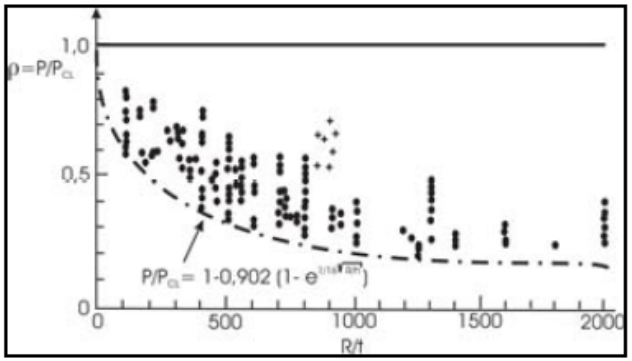
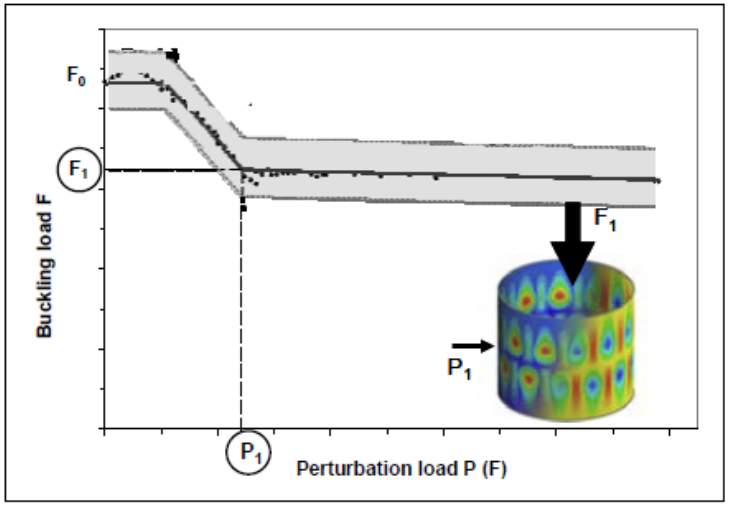
DESICOS – Combining stochastic and deterministic

DESICOS

Current design scenario (*NASA SP 8007*)

Future design scenario: *Single Perturbation Approach* + *Stochastic Approach*





$F_{Design} = F_{perfect} * \rho_{NASA}$

ρ_{NASA} = Knock down factor NASA 8007

$F_{Design} = F_{perfect} * \rho_1 * \rho_2$

ρ_1 = Knock down factor *Single Perturb. Approach*

ρ_2 = Knock down factor *Stochastic Approach*

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Programm

25th March (Day 1)

8.30	*Registration*
9.45	*R. Degenhardt - Welcome*
10.00 - 12.00	Keynote lectures
13.00 - 14.40	DESICOS - Workpackage summaries
	Online-session: access via www.ifarlink.aero
15.10 - 17.30	DESICOS - Achievements of the PhD students - New design concepts
18.00	*Transfer to Dinner*
18.30 - 22.30	Conference Dinner (at Dornse) 1) Welcome by Mrs. Annegret Ihbe (Mayoress of the City) 2) Dinner speech: Prof. Joachim Block (ROSETTA Lander - a challenging mission to the origins of the solar system)
22.45	*Transfer to hotels*

26th March (Day 2)

8.00	*Registration*		
8.30 - 10.00	Keynote lectures		
10.30 - 12.30	Improved theories / concepts	Damaged structures	Design and analysis
12.10 - 15.00	DESICOS Workshop (Demonstration of improved tools, designs, testing)		
15.00 - 17.30	Semi-analytical concepts	Experiments	Design and analysis
18.00	*Transfer to DLR*		
18.30 - 20.30	DLR visiting lab tour		
20.45	*Transfer to hotels*		

27th March (Day 3)

8.00	*Registration*	
8.30 - 10.00	Keynote lectures	
10.30 - 12.10	Experiments	Design and analysis
13.00 - 14.20	New concepts	Design and analysis
15.00 - 16.30	Keynote lectures	
16.30	*R. Degenhardt - Closing*	
16.35	*End of Conference*	

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Thanks to

- IFAR – International Forum for Aviation Research
  - www.ifar.aero
  - www.ifarlink.aero
- NASA
- DLR
- JAXA

Time:	Chair: Chiara Bisagni (TU-Delft)
3.10 pm	Introduction (Richard Degenhardt (DLR)
3.20 pm	K. Liang, M. Ruess (TU-Delft)
	New robust knock-down factors for the stiffened cylinder
3.40 pm	A. Meurer, M. Dannert, R. Rolfes (Leibniz University Hannover)
	New Design Approach for Axially Compressed Composite Cylindrical Shells combining the Single Perturbation Load Approach and Probabilistic Analyses
4.00 pm	S. G. P. Castro, C. Mittelstedt, F. A. C .Monteiro, M. A. Arbelo , R. Degenhardt, G. Ziegmann (PFH, DLR, TU Clausthal. Sogeti)
	A semi-analytical approach for linear and non-linear analysis of unstiffened laminated composite cylinders and cones under axial, torsion and pressure loads
4.20 pm	M. Alfano, C. Bisagni (Politecnico di Milano)
	Reliability assessment of buckling response of an axially compressed sandwich composite shell with and without cut-outs
4.40 pm	L. Friedrich, H. Reimerdes, K. Schröder (RWTH Aachen)
	Advanced sizing strategies for preliminary design of orthotropic grid stiffened shell structures
5.00 pm	R. Khakimova, R. Degenhardt (DLR)
	Assessment of the Single Perturbation Load Approach on composite conical shells
5.20 pm	J. Kepple, M. Herath, G. Pearce, G. Prusty, R. Thomson (CRC-ACS, University of New South Wales, Advanced Composite Structures Australia)
	Stochastic analysis of imperfection sensitive composite cylinders using realistic imperfection models
5.40 pm	Discussion
5.50 pm	End

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