UK ACTIVITIES

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VUT v Brně

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ÚSTAV
KONSTRUOVÁNÍ

Content

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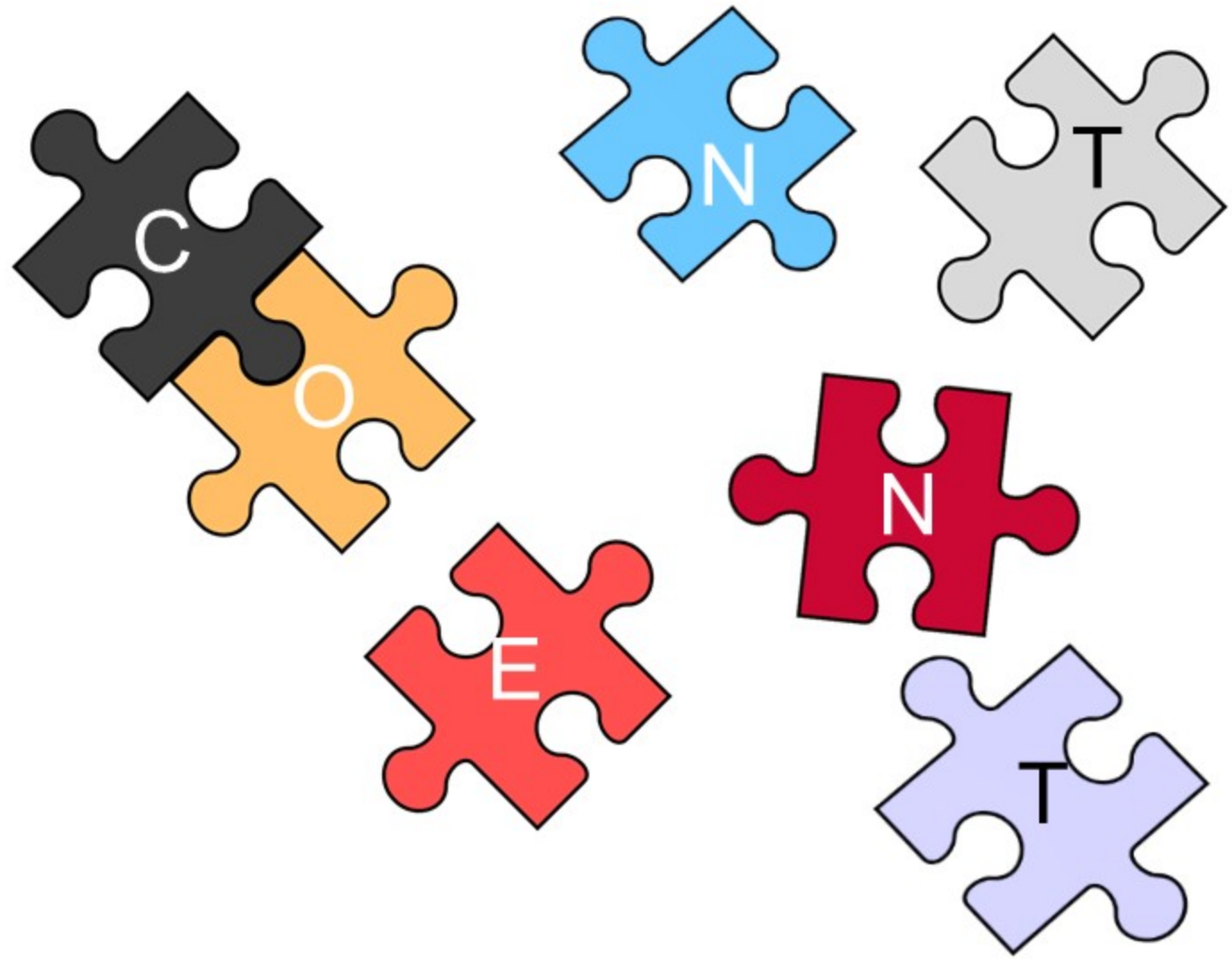


Introduction

Dissertation Thesis

- Study of the behavior the coated plastic teeth

Supervisor

- prof. Ing. Ivan Křupka, Ph.D

Expert consultant

- Ing. Petr Šperka, Ph.D

Introduction

Name of the Project:

Thermo-Elastohydrodynamics of Coated Polymer Gears (GACR385000)

- Brno University of Technology (**Prof. Ing. Martin Hartl, Ph.D.**),
  - Institute of Machine and Industrial Design (ÚK),
- Technical University Munich (**Univ.-Prof. Dr.-Ing. Karsten Stahl**),
  - Gear Research Centre (FZG),
- RWTH Aachen University (**Univ.-Prof. Dr.-Ing. Kirsten Bobzin**),
  - Surface Engineering Institute (IOT)

Business trip: Munich, July 2018 Aachen, March 2019

Introduction

Polymer (hybrid) gears:

- Polymer gears
  - Unlubricated
  - Lubricated

✓ Advantages of polymer gears:

- Low production costs,
- Low mass,
- Less centrifugal forces,
- Self-lubricating,
- Ability of work without an external lubricant.

✗ Disadvantages of polymer gears:

- Low mechanical properties ($E < 5\ GPa$),
- Significant dependence of mechanical properties on temperature,
- Viscoelastic behavior.

Engineering polymers for gears:

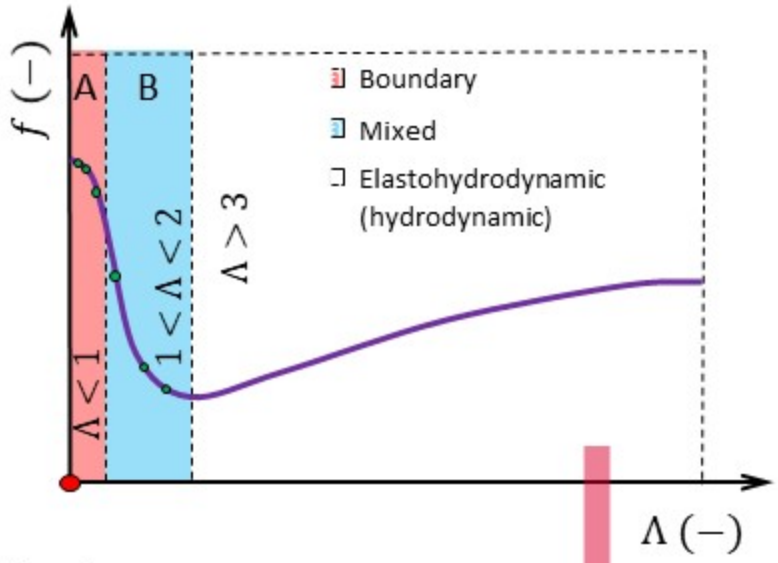
- PA 66
- PA 6
- POM
- PEEK
- UHMW-PE

Spur gears

Worm gears

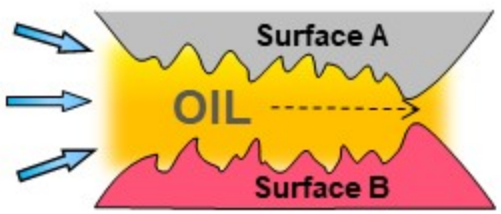
Motivation

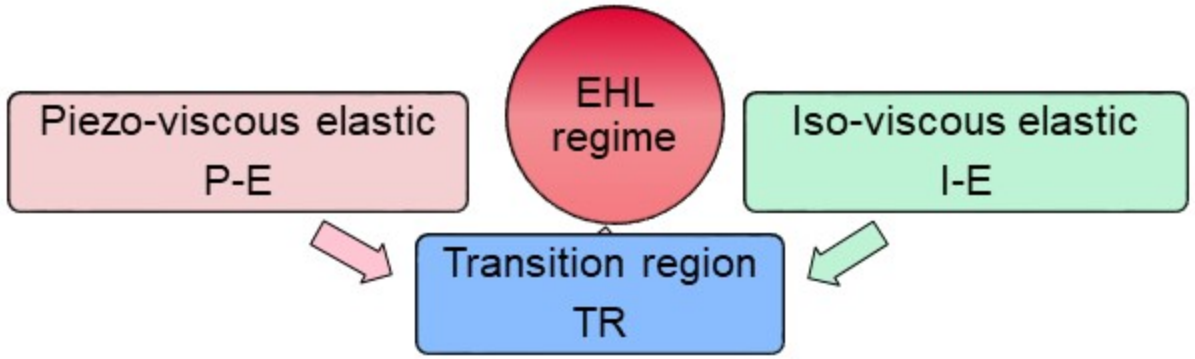
Lubrication regimes:

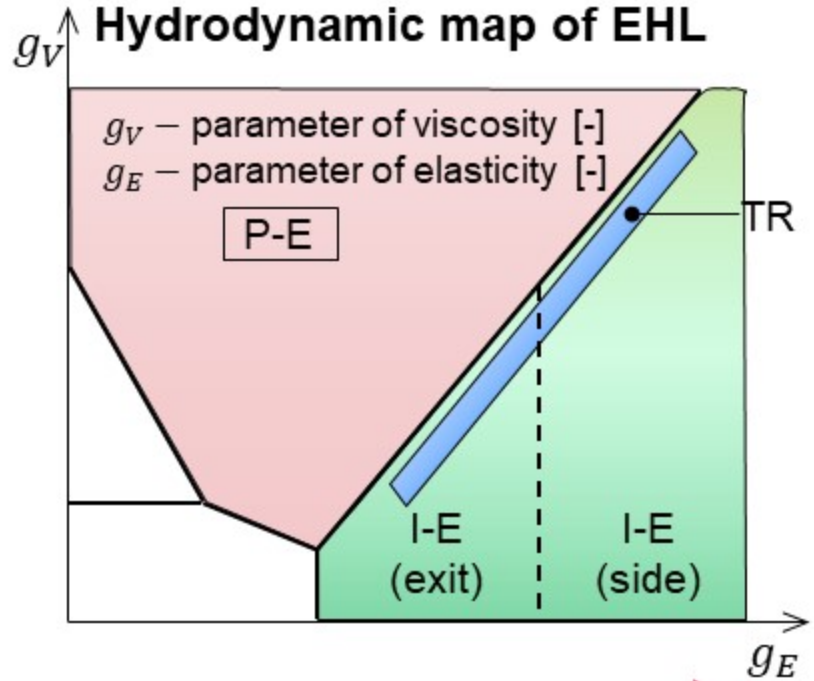


Lubrication parameter

$$\Lambda = \frac{h_{min}}{\sqrt{{R_{q1}}^2 + {R_{q2}}^2}}$$







Aims

Tasks:

Uncoated polymers & Coated polymers

Film thickness distribution

- The effect of governing parameters(load,speed,piezo viscosity,elipticity)?
- The effect of temperature on film thickness?
- The effect of non-Newtonian rheology

Development of friction

- The effect of governing parameters (load,speed, materials, lubricants)?
- The effect of temperature on friction?

Topography of surface

- Development of surface texture parameters Sa and Sq
- Macromolecular changes of surface

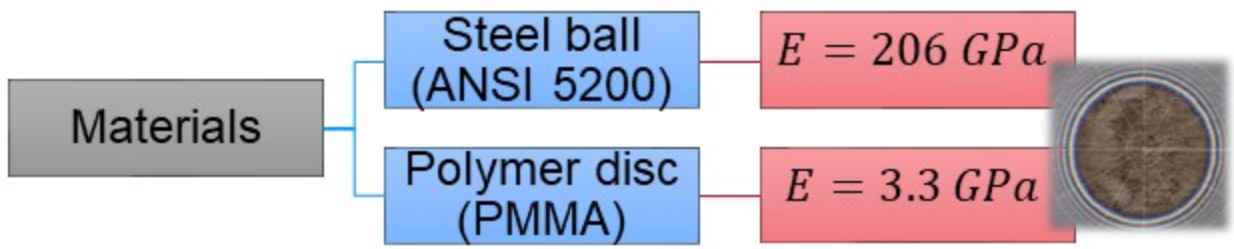
Comparison with EHL theory → Comparison with numerical simulations →

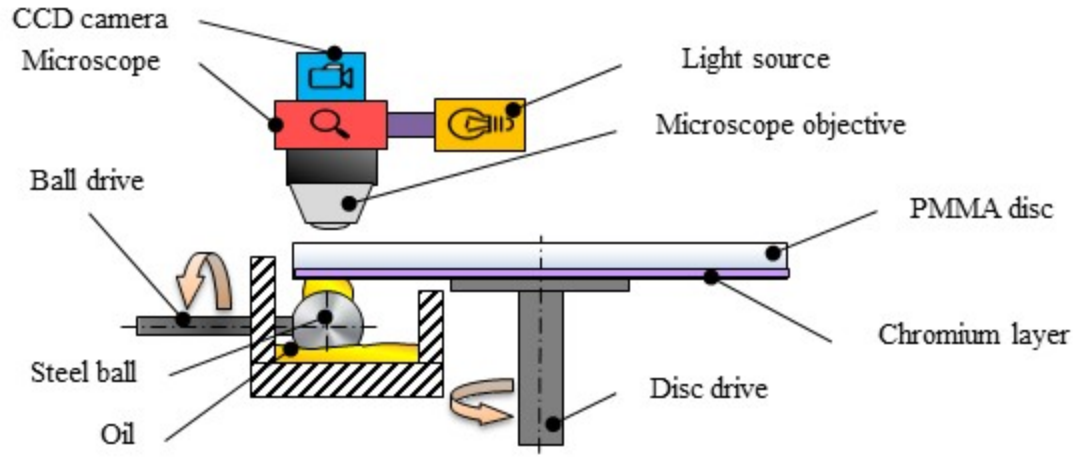
Comparison with real conditions

Experiments

Measurement of the film thickness:

Experiment conditions	Value
Load W(N):	10; 15; 20
Entrainment speed U (m/s):	0,02-0,3
Oil temperature T $(°C)$:	24 ± 0.5
Sliding - rolling ratio *SRR* $(-)$	0
TOTM oil viscosity η $(\mathrm{mPa} \cdot \mathrm{s})$	222
Hertz pressure p (MPa)	55; 64; 70





Experimental apparatus.

Circular contact

Results

Measurement of the film thickness:

Experiment conditions	Value
Load $W(N)$:	10; 15; 20
Entrainment speed U (m/s):	0,02-0,3
Oil temperature T $(°C)$:	24 ± 0.5
Sliding-rolling ratio *SRR* $(-)$	0
TOTM oil viscosity η $(mPa \cdot s)$	222
Hertz contact pressure p (MPa)	55; 64; 70

Experimental results

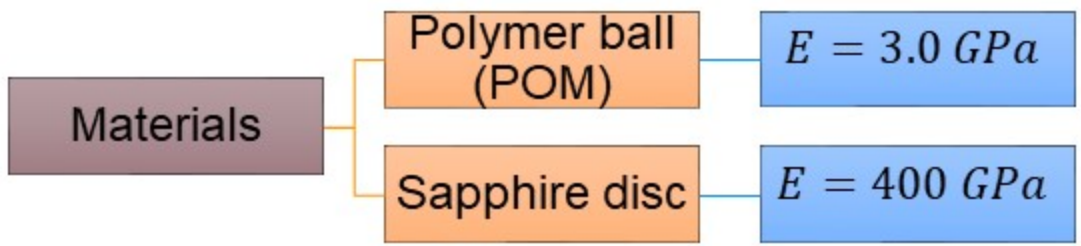
Comparison:

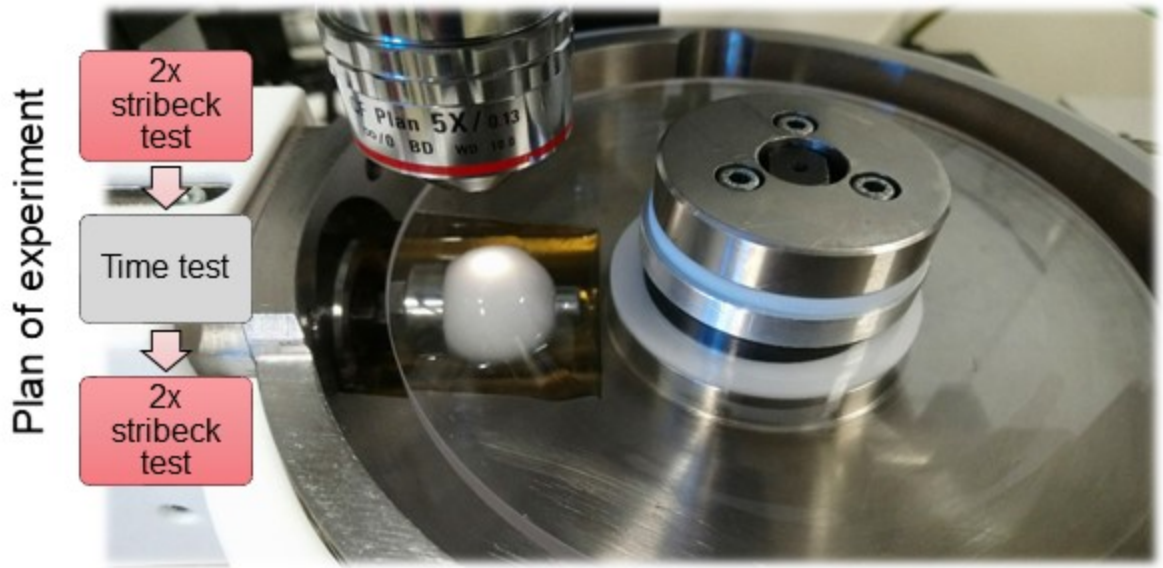
Experimental data → EHL theory → Numerical simulation

Experiments

Measurement of the coefficient of friction:

Experiment conditions	Value
Load W(N):	50
Entrainment speed U (m/s):	0,01-2,00
Oil temperature T $(°C)$:	30; 50; 70; 90; 110
Sliding-rolling ratio *SRR* $(-)$	0.25; 0.50
FVA3 oil viscosity η $(\mathrm{mPa}\cdot\mathrm{s})$	230
Hertz contact pressure p (MPa)	~85





Ball on disc tribometer

- Measurement of friction (CoF)

Optical profilometer

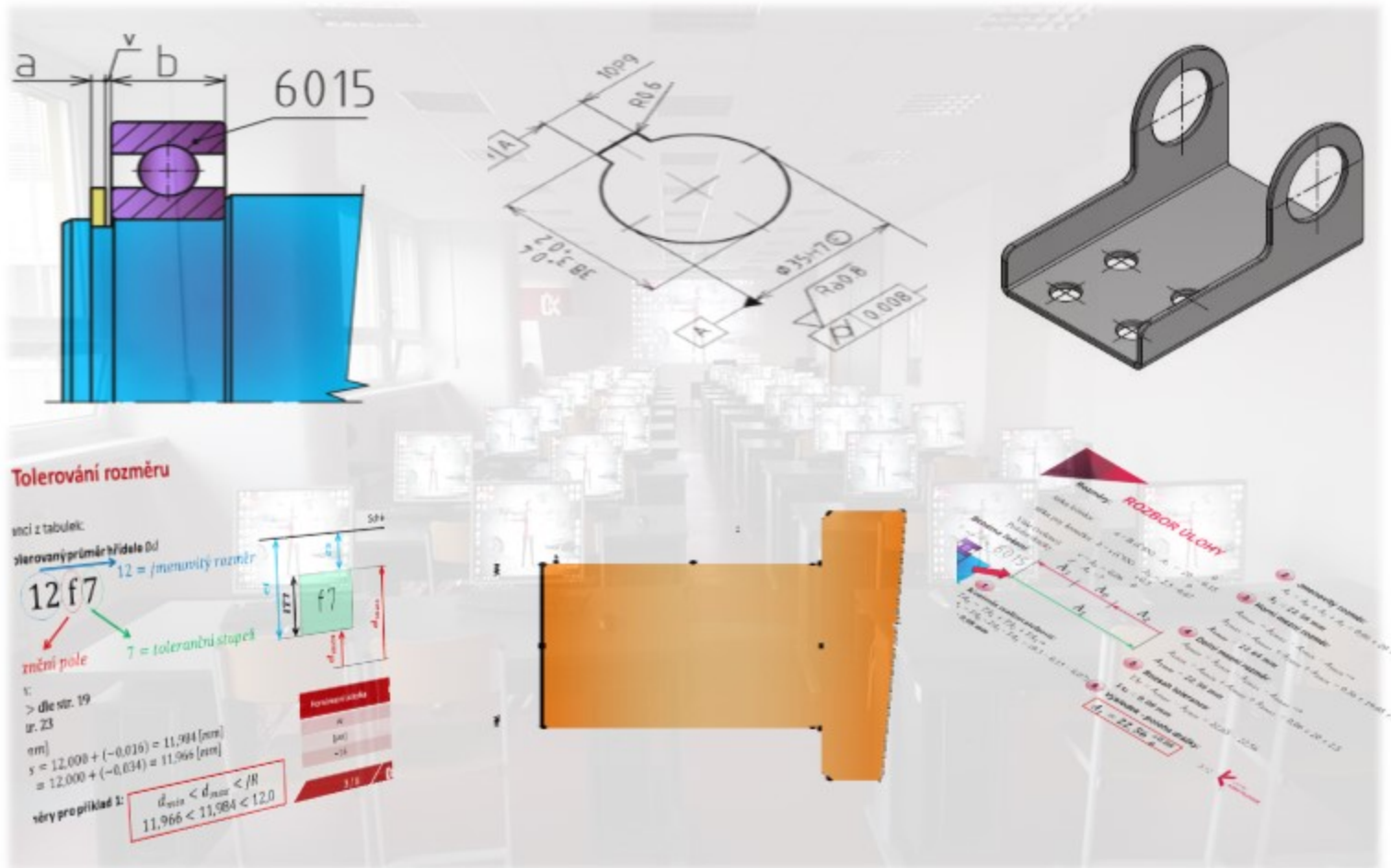
- Measurement of surface topography (Rq)

Educational

EDUCATIONAL ACTIVITIES

Teaching

Subject	Počet cvičení
3CD-2017/2018	3
1K-2017/2018	1
2K-2017/2018	1
4KC-2017/2018	2
3CD-2018/2019	4
4KC-2018/2019	3
Počet studentů	~400

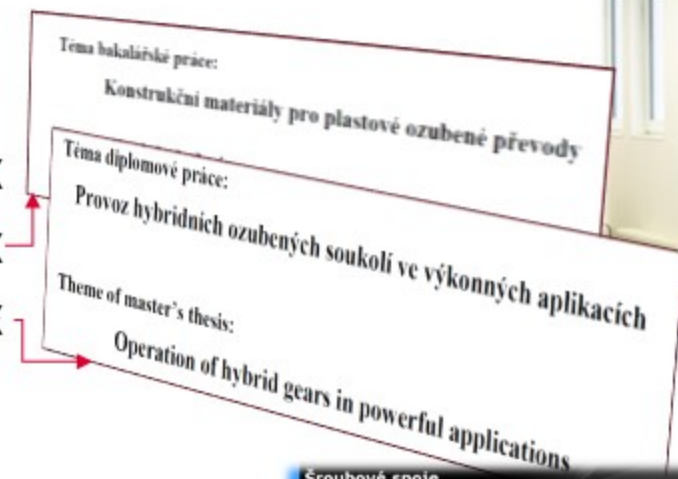


Others

OTHER ACTIVITIES

Bachalor & Diploma thesis:

- 2017/2018 B - opponent 1x
- 2018/2019 B - supervisor 1x
- 2019/2020 D - supervisor 1x



Creating lecture presentations:

- 5KS
- 6KT

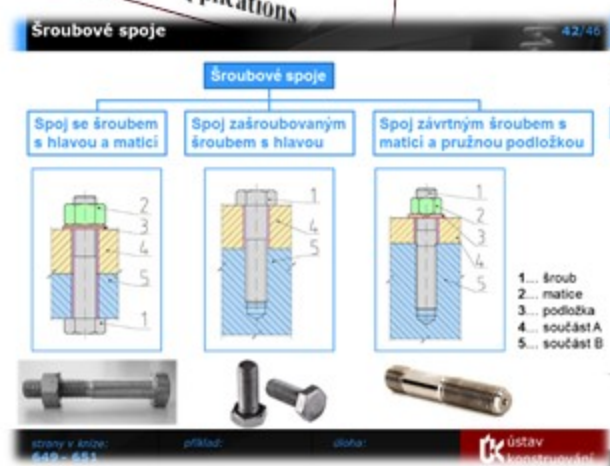
Open doors day (member of UK team):

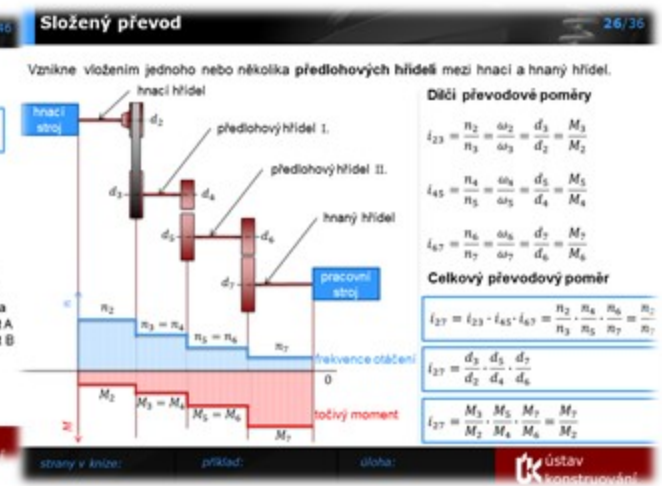
- 2017/2018 2x
- 2018/2019 2x

Open doors day on FSI (January 2019)

Fond vědy (member of committee):

- 2017/2018
- 2018/2019





Lecture presentations (5KS and 6KT)

THANK YOU FOR YOUR ATTENTION

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