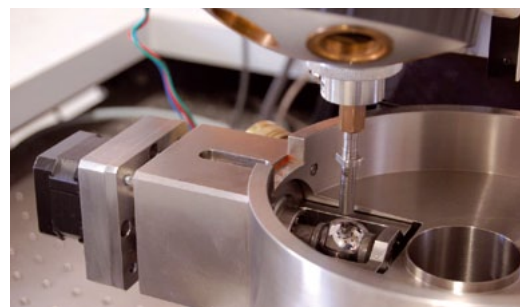


## RESEARCH GROUP CONTACT >>

Technická 2896/2, 616 69 Brno, Czech Republic  
<http://uk.fme.vutbr.cz/>

HEAD Prof. Martin Hartl  
PHONE +420 54114 2769  
E-MAIL [hartl@fme.vutbr.cz](mailto:hartl@fme.vutbr.cz)



## THEMATIC RESEARCH FOCUS >

### RESEARCH AREA

- » Tribology – biotribology, nanotribology, surface texturing, starved lubrication, speed and load changes in elastohydrodynamic contact, oil degradation measurements, and transient behaviour of elastohydrodynamic contact
- » Experimental study of real roughness attenuation in rolling/sliding concentrated contacts
- » Mechanical Degradation of the Liquid in an Operating EHL Contact
- » Effect of surface texturing on elastohydrodynamically lubricated contact under transient speed conditions

### EXCELLENCE

- » Tribology – very thin EHD films measurement
- » Behaviour of surface roughness inside an elastohydrodynamic contact
- » Transient behaviour of elastohydrodynamic contact using a very high-speed camera

### MISSION

- » Friction and wear reduction with respect to ecology
- » Development of new measurement techniques in tribology
- » The validation of theoretical models in the field of elastohydrodynamic lubrication, used for the design of highly loaded machine parts (esp. rolling bearings)

## DEVELOPED TECHNOLOGIES >

### CONTENT OF RESEARCH

- » Elastohydrodynamic Lubrication (EHL), Contact Mechanics
- » Transient behaviour of elastohydrodynamic contacts.

- » Behaviour of surface roughness inside a elastohydrodynamic contact.
- » Biotribology
- » Nanotribology

### MAIN CAPABILITIES

The Tribology Laboratory has history of more than 12 years and is recognized as a distinguished lab in specific field. A new experimental technique for the study of thin lubricant films by means of colorimetric interferometry has been developed here. This technique is able to provide real time data for thin lubricant film shape studies. The essential part of the lab is represented by an experimental apparatus for the study of elastohydrodynamic lubricant films based on a computer controlled dynamic Fizeau interferometer. Recently, a 3D optical profilometer based on phase shifting interferometry has been incorporated to measure in-situ initial undeformed real surface topography. Latest results published in scientific journals have proved the combination of thin film colorimetric interferometry with phase shifting interferometry to be one of the most powerful tools for the investigation of mixed lubrication of real surfaces in situ. This laboratory enables practice verification experiments to be performed in precisely known conditions and ensure true and repeatable results. About 80 percent of machines are disabled as a result of the damage of thin surface layers caused, among other things, by the local breakdown of elastohydrodynamic lubrication films. It is in the close relation to the lubricant capability to create coherent protective film. It is mostly characterised by the film thickness dependence on operation conditions (speed, load, temperature etc.) and rubbing surfaces topography.

### FIELDS OF RESEARCH RESULTS APPLICATION

- All fields of engineering (in production mainly industrial design)
- » Construction - civil engineering
  - » Electrical Engineering
  - » Engine construction
  - » Automotive industry
  - » Railway transport
  - » Energy saving



- » Materials - Iron and Steel, Non ferrous materials, Plastics, Polymers
- » Software
- » Medical Equipment

#### ALUMNI PROFILE

The mission is to provide a high quality education, research and service to the industry in the field of modern machine design including integration of computer and information technology into products and processes.

Advantages of specialization are progressive technology, versatility, flexibility and a theoretical base. Graduates from this specialization can be employed mainly in design, in research and development departments or as project engineers, manufacturing, members and leaders of project teams, businessmen in the area of mechanical engineering and CAD applications.

#### NUMBER OF RESEARCH POSITIONS ↘

##### SENIOR RESEARCH STAFF

6

##### JUNIOR RESEARCH POSITIONS (INCL. PH.D. STUDENTS)

8

#### KEY RESEARCH EQUIPMENT ↘

##### LIST OF DEVICES

- » Tribometer to study the behaviour of very thin lubricant films
- » 3D optical profilometer
- » Instruments for lubricant diagnostics

#### Laboratories:

- » Very high-speed camera
- » Digital viscosimeter
- » Refractometer
- » Contact fatigue
- » Bearing life
- » Fatigue of machine parts

#### BUDGET ↘

##### TOTAL (MIL. CZK/ MIL. EUR)

6 / 0.24

##### PART OF THE TOTAL BUDGET FROM PRIVATE RESOURCES (%)

40

##### PART OF THE TOTAL BUDGET FROM FOREIGN RESOURCES (%)

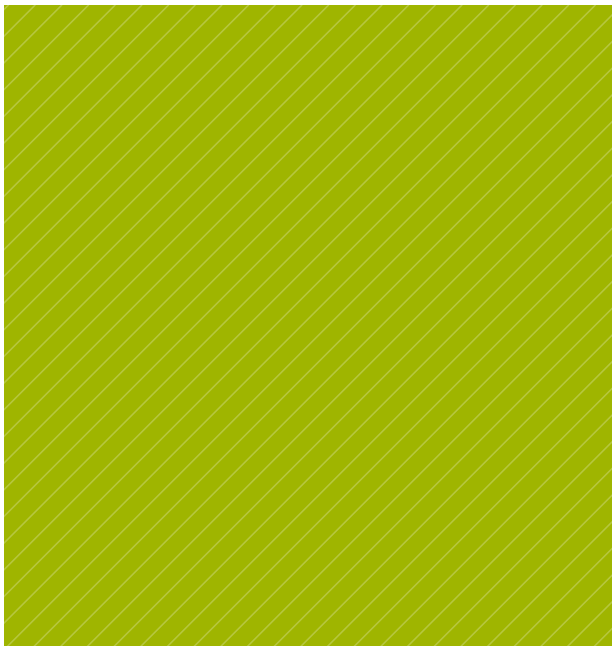
10

#### MAIN PROJECTS ↘

**2009-2011:** Experimental study of elasto-hydrodynamic and mixed lubrication of hypoid gears (project GC101/09/J003 financed by the Czech Science Foundation)

**2007-2011:** Effect of surface topography modifications on lubrication films efficiency to diminish friction and wear of machine parts (project ME 905 financed by the ME – KONTAKT programme, Ministry of Education, Youth and Sports)

**2005-2007:** Influence of surface topography on lubricated contacts (project 1P05OC009 financed by the Ministry of Education, Youth and Sports)



## ACHIEVEMENTS ↘

KŘUPKA, I.; HARTL, M.; BAIR, S.; KUMAR, P.; KHONSARI, MM. (2010) The Effect of Load (Pressure) for Quantitative EHL Film Thickness, *TRIBOLOGY LETTERS*, 37(3), 613 – 622.

KŘUPKA, I.; HARTL, M.; BAIR, S.; KUMAR, P.; KHONSARI, MM. (2009) An Experimental Validation of the Recently Discovered Scale Effect in Generalized Newtonian EHL. *TRIBOLOGY LETTERS*, 33(2): 127 – 135.

KŘUPKA, I.; HARTL, M.; SVOBODA, P. Effects of surface topography on lubrication film formation within elastohydrodynamic and mixed lubricated non-conformal contacts. *PROCEEDINGS OF THE INSTITUTION OF MECHANICAL ENGINEERS PART J-JOURNAL OF ENGINEERING TRIBOLOGY*. 2009. 223(6). p. 1 – 9.

KŘUPKA, I.; SVOBODA, P.; HARTL, M. Effect of surface topography on mixed lubrication film formation during start up under rolling/sliding conditions. *Tribology International*. 2009. 43(4). p. 1 - 9.

KŘUPKA, I.; HARTL, M. (2007) The influence of Thin Boundary Films on Real Surface Roughness in Thin Film, Mixed EHD Contact. *TRIBOLOGY INTERNATIONAL*, 40 (10-12): 1553-1560.

Maurice Godet Award | Leeds Lyon 2009 – award for the best presentation / paper by a young scientist.

## MAIN COLLABORATING PARTNERS ↘

### COLLABORATION WITH ACADEMIC PARTNERS

- » University of Munich (Munich, DE)
- » University of Seoul (Seoul, KR)
- » University of Shanghai (Shanghai, CN)
- » Georgia Institute of Technology (Atlanta, US)
- » Kyushu Institute of Technology (Kitakyushu, JP)
- » Tsinghua University (Beijing, CN)
- » INSA (Lyon, FR)
- » Kookmin University (Seoul, KR)
- » Northwestern University (Chicago, US)

### COLLABORATION WITH COMPANIES

- » Škoda-auto (Mladá Boleslav, CZ)
- » Eaton Corp. (US)
- » Koyo Bearings (JP)
- » Tribotec (Brno, CZ)
- » ZKL (Brno, CZ)
- » Bosch Rexroth Czech Republic (Brno, CZ)
- » Timken Czech Republic (Brno, CZ)
- » INA Schaeffler (DE)

## EXPECTATIONS ↘

### REQUIREMENTS

- » Rational project plan
- » Ambitious and realistic requests for scientific services – challenge for further research development
- » Direct support of research for industry, focused on specific requirements of the company. Long-term projects will be preferred, short term projects are also possible

### OFFERS

- » Comprehensive development services for firms – in relation with NETME Centre
- » Research activities include contact fatigue, bearing life, fatigue of machine parts, nanotechnology
- » Machine and industrial design including 3D models
- » Utilization of university capacities and acquisition of new specific equipment, operated by university staff
- » Products for commercialization (we cannot be more factual because of competition)

