

Contact Mechanics and Elements of Tribology

Foreword

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@ Centre des Matériaux (virtually)
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- Acquaintance
- Questionnaire
- Teaching team
- Course content
- Complexity of contact physics
- Notations

Teaching team



- **Henry Proudhon** (@CNRS, France) - Fretting and Wear
- **Andrei Shvarts** (@Glasgow University, UK) - Lubrication and Sealing
- **Ramin Aghababaei** (@Aarhus University, The Netherlands) - Nanoscopic wear
- **Vladislav Yastrebov** (@CNRS, France)

Zoom and operational mode

- That's our first experience to give our course in hybrid mode for so many people, so please be patient with technical problems.
- In case of such problems, please write in Zoom chat, we'll try to solve them asap.
- Please do not record the course, one day, I'll do it on my own 😊
- Please don't share zoom links neither. If someone would like to attend, please write me an email.
- During lectures, I'll accept oral question only from people in the room and DMS students.
- For all Zoom participants, please write your questions in Google.Sheet, I'll try to address them later.
- All slides are available on www.yastrebov.fr/teaching.html
- All links will be provided in Google.Sheet of the course (please be careful with this online document)

Monday

- Lecture: Industrial Applications
- Lecture: Continuum Contact Mechanics
- Blackboard: Flamant's problem

Tuesday

- Lecture: Contact mechanics and material behavior
- Lecture: Contact at small scales: roughness
- Practical work: Integration of Flamant's solution

Wednesday

- Lecture: Computational Contact Mechanics
- Lecture: Lubrication and Sealing (*A.G. Shvarts?*)
- Practical work: Contact algorithms (FEM)

Thursday

- Lecture: Fretting and wear (*H. Proudhon*)
- Lecture: Friction and adhesion
- Practical work: some contact problems (analytical and numerical solutions)

Friday

- Seminar: *Elastodynamic friction*
- Seminar: *Fluid-solid interaction in leakage problems* (A. Shvarts)
- Seminar: *Micromechanics of material detachment during sliding contact - a new look at the old problem of wear* (R. Aghababaei)
- Exam for all
- Concluding remarks

Exam and notes

- On Friday, February 12th at 14h00.
- 20-25 questions on lectures of the first four days (Monday-Thursday)
- Duration: 2.5 hours
- Type of questions: technical questions which generally require some calculations
- No lecture notes ☹, so please be attentive during the classes and take notes on your own
- You will be allowed to use whatever you want
- The exam is “mandatory” for all the participants:
 - If you need a certificate of attendance. By the way to get it, you'll need to attend all lectures and practical sessions...
 - If you would like to try to get certificate of Excellence
- Final notes are essential for DMS participants to validate the course



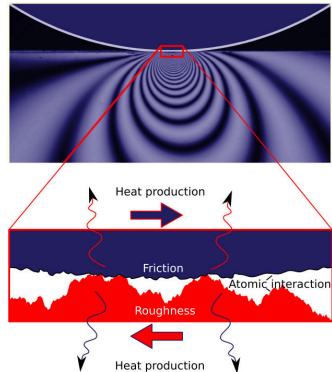
Well, for 5 years that I give this course, I haven't yet signed a single such certificate...



Contact complexity: physics and mathematics

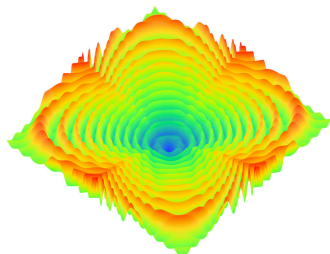
Particular difficulties related to contact problems:
multiphysical aspects, mathematical aspects

- Fractality of surfaces
- Interface chemistry
- Hardly accessible contact interface for measurements
- Generation and diffusion of heat
- Multiscale and multiphysical nature of friction



Particular difficulties related to contact problems: multiphysical aspects, **mathematical aspects**

- One of the most hard problems in mechanics
- Lack of standard optimization problem
- Non-convexity and non-differentiability
- Non-continuous character
- Bad scalability





Welcome to the CMET course!
