The contact mechanics challenge (proposed by Martin H. Müser, Saarland University)

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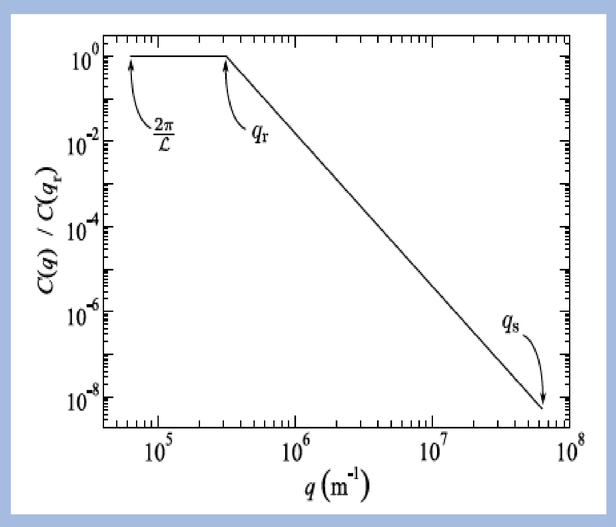
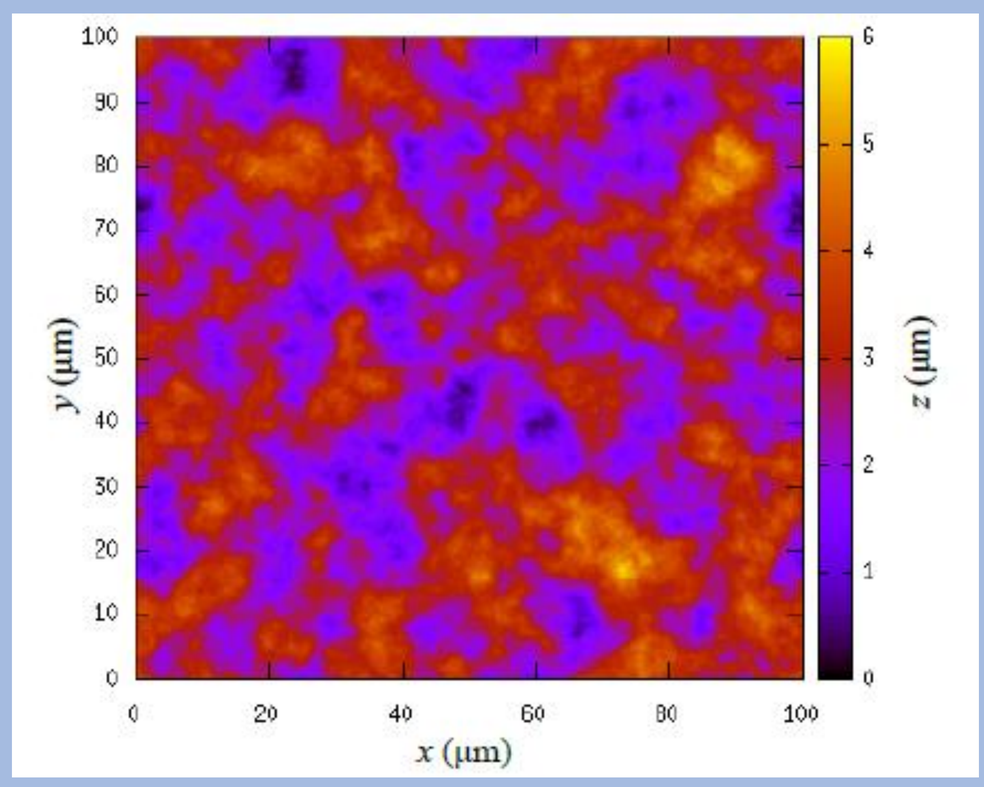
Adhesion between a rough rigid surface and a flat elastic plane

Surface topography : produced from its Power Spectrum

$$sqrt\left(< h^2 >\right) = 0.762\ \mu m$$
$$sqrt\left(< \partial h^2 >\right) = 1$$





Material parameters : E^* = 25 Mpa

Mean pressure : P_m = 0,25 MPa

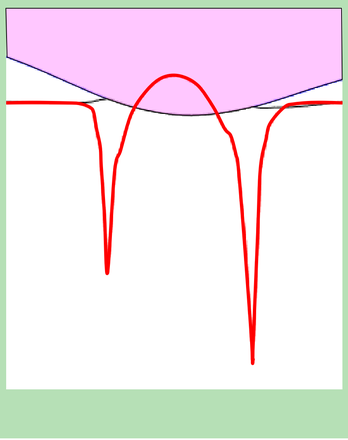
Surface Energy : γ_o = 50 mJ/m²

Local Tabor Number : μ_T = 3 → Short-range adhesion

High adhesion stresses

High adhesion stresses at the edge of the contacting asperities

very fine discretization



Our method

"Brute-force computing"
FFT + Conjugate Gradient method

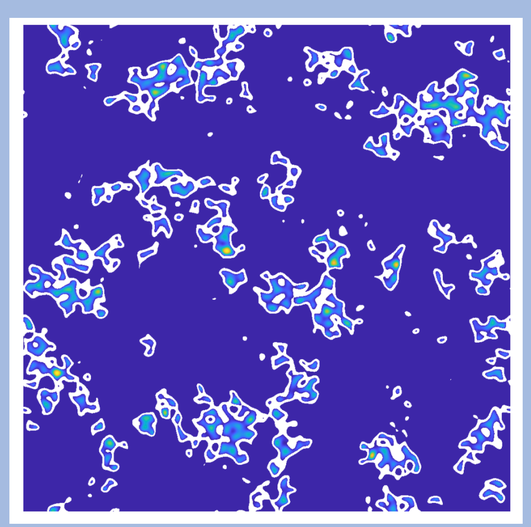
32Kb x 32Kb on 150 Gb of RAM
4Kb x 4Kb on a standard laptop
1Kb x 1Kb less than 1 min of calculation time

reproduces the reference solution very accurately

Results

no contact
negative pressure

Roughness details and short-range adhesion need a lot of discretization points



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The competitors

- ✓ INSA Lyon, France
- ✓ Peter Grünberg Institute (PGI), Germany
- ✓ University of Freiburg, Germany
- ✓ Karlsruhe Institute of Technology (KIT), Germany
- ✓ Auburn University, USA
- ✓ University of Florida, USA
- ✓ Georgia Institute of Technology, USA
- ✓ Johns Hopkins University, USA
- ✓ Isfahan University of Technology, Iran
- ✓ Chang Gung University, Taiwan
- ✓ AC²T research GmbH, Austria
- ✓ University of Groningen, The Netherlands
- ✓ Imperial College, UK
- ✓ University of Cambridge, UK
- ✓ Polytechnic University of Bari, Italy

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