

Lehrveranstaltungsankündigung WS 2015/16

Project “Asymptotic modelling of the JKR adhesive contact for a thin elastic layer”

Umfang: 6 LP ECTS

Sprechstunden: nach Vereinbarung

Anrechenbarkeit:

Diplom: PI, VW, Maschinenbau, Werkstoffwissenschaften u.a.
Bachelor und Master PI: Projekt im Rahmen eines individuellen Studienverlaufplans,
Alle Studiengänge: Wahlfach

Content:

The JKR (Johnson–Kendall–Roberts) theory of adhesive contact [1] was originally developed for the case of spherical contact (e.g., for a spherical rigid indenter in frictionless contact with an isotropic elastic half-space). A generalization of the JKR theory for a layered media was considered in a number of papers (see, e.g., [2,3]). The case of a thin elastic layer in contact with a rigid spherical indenter (or the case of contact between rigid spheres coated with thin elastic layers) requires a special consideration. Previously, asymptotic models for axisymmetric adhesive indentation of a thin *isotropic* elastic layer and a spherical or conical indenter were developed in the incompressible [4] and compressible [5,6] cases.

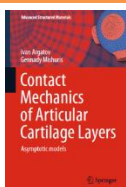
Based on the recently developed asymptotic models for deformation of thin elastic layers [7], it is suggested to generalize the JKR theory for an *arbitrary* axisymmetric indenter (with a circular contact area) and a thin *transversely isotropic* elastic layer (both in the compressible and incompressible cases).

The approach of asymptotic modelling is a multi-sided analysis of the problem under investigation combining an approximate analytical treatment with numerical simulations. Such a harmonious approach in mathematical modelling will enable to unify generality of the problem statement and accuracy of the numerical results with a fundamental understanding of the investigated phenomena that is provided by the relatively simple asymptotic models.

In the project, you will learn the theoretical foundations of the adhesive contact and the practical operation of the asymptotic modelling and apply them to such an application-oriented problem.

The project report is anticipated in the form of an original research paper.

- [1] Johnson KL, Kendall K, Roberts AD. *Proc. R. Soc. London, Ser. A* **324** (1971) 301–313.
- [2] Sridhar I, Johnson KL, Fleck NA. *J. Phys. D: Appl. Phys.* **30** (1997) 1710–1719.
- [3] Barthel E, Perriot A. *J. Phys. D: Appl. Phys.* **40** (2007) 1059–1067.
- [4] Yang F. *J. Phys. D: Appl. Phys.* **35** (2002) 2614–2620.
- [5] Reedy ED. *J. Mater. Res.* **21** (2006) 2660–2668.
- [6] Yang F. *Thin Solid Films* **515** (2006) 2274–2283.
- [7] Argatov I, Mishuris G. *Appl. Math. Model.* **35** (2011) 3201–3212.



Begleitend zum Projekt gibt es ein Buch (Englisch):

Argatov I, Mishuris G. **Contact Mechanics of Articular Cartilage Layers: Asymptotic Models**. Springer, Cham, Switzerland (2015).

Zu speziellen Problemen gibt es weitere umfangreiche Literatur.