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Bachelor thesis - *Bachelorarbeit*

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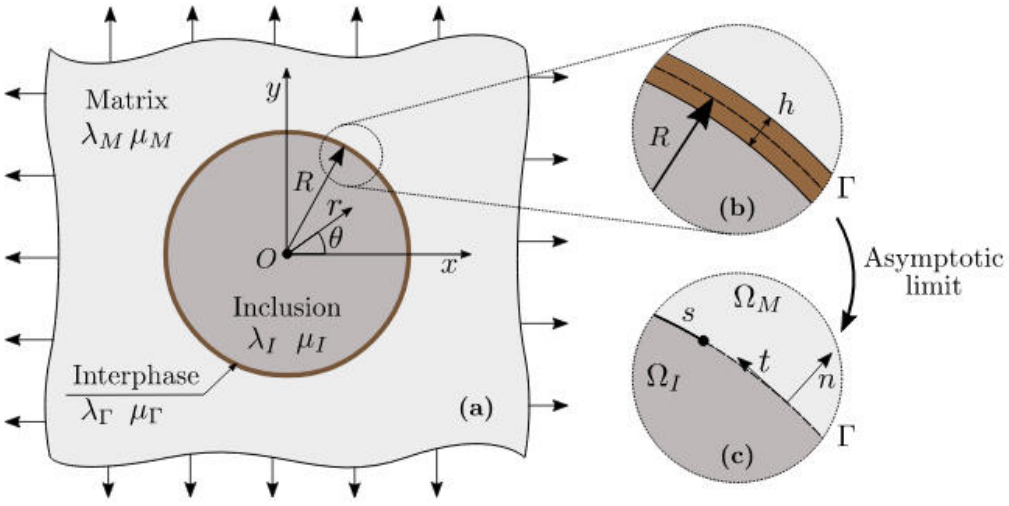
Second examiner: Prof. Dr.-Ing. U. Nackenhorst	

Computational Investigation of the Validity of Higher-Order Imperfect Interface Models with respect to Layer Thickness

Numerische Untersuchung der Gültigkeit von Interface-Modellen höherer Ordnung in Abhängigkeit der Schicktdicke

Dealing with heterogeneous materials and structures requires advanced modeling and simulation technologies in interface modeling. A classical approach is asymptotic interface modeling where the interphases are reduced dimensionally [1].



The corresponding asymptotic limit at the interface of a three-phase inhomogeneity problem [1, Figure1]

As a side effect, the resulting formulation includes higher-order differential operators. One can formulate the transmission conditions at the interface in terms of the jumps and averages of the displacement and stresses solutions. The finite element treatment of the interface and its discontinuous solutions is enabled by applying the

cut finite element methods (FEM) and higher order smooth spline basis functions [2].

The asymptotic interface model includes the layer thickness as a parameter. The interface modeling is based on the assumption of thin layers. When the layer thickness reaches certain limit, the gap between the interface and the three-phase model is no longer acceptable and the interface model is not valid anymore. The goal of this thesis is to establish the validity of the interface model with respect to the layer thickness.

Within the scope of this thesis, the student should study the cut FEM and spline basis functions in imperfect interface modeling. He/she should understand the existing codes of the interface model in C++ and create a reference model using FEM-Software (e.g. ABACUS, ANSYS etc.). The result of these two models should be then compared and discussed. The validity of the interface model should be discussed with respect to the layer thickness in term of a dimensionless parameter, for example in relation with the radius of the circular interface.

Prerequisites are an interest into different methods in interface modeling and finite element methods, as well as first experiences with programming in C++ and with FEM-Softwares. The language of the thesis could be English or German.

Literature:

[1] Z. HAN, S.K.F. STOTER, C.T. WU, C. CHENG, A. MANTZAFLARIS, S. MOGILEVSKAYA, D. SCHILLINGER (2018): Consistent discretization of higher-order interface models for thin layers and elastic material surfaces, enabled by isogeometric cut-cell methods. *Computer Methods in Applied Mechanics and Engineering*, 350:245-267, 2018.

[2] D. SCHILLINGER, M. RUESS (2015): The Finite Cell Method: A review in the context of higher-order structural analysis of CAD and image-based geometric models. *Archives of Computational Methods in Engineering* 22(3):391-455, 2015.