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Selected publications

[1] K. Unterweger, T. Dick, R. Pippan, O. Kolednik. The local composite architecture of MMCs – Effects on the local deformation and fracture behavior. Journal de Physique IV (Proceedings), Volume 105, Issue 3, March 2003, pp.115-122.

[2] T. Dick, G. Cailletaud. Analytic and FE computation of a composite coefficient of friction, Wear, Volume 260, Issues 11-12, June 2006, pp. 1305-1316.

[3] T. Dick, C. Paulin, G. Cailletaud, and S. Fouvry. Experimental and numerical analysis of local and global plastic behaviour in fretting wear. Tribology International, Volume 39, Issue 10, October 2006, pp. 1036-1044.

[4] T. Dick, G. Cailletaud. Numerical modelling in fretting of TA6V including crystal plasticity, In Tribologie dans les transports (ed. J. Denape, J.-Y. Paris, P. Stempflé), pp.75-84, Presses polytechniques et universitaires romandes, Lausanne.

[5] T. Dick, G. Cailletaud. Fretting modelling with a crystal plasticity model of Ti6Al4V. Computational Material Science, Volume 38, Issue 1, November 2006, pp. 113-125.

[6] F. Franek, A. Pauschitz, V.E. Lazarev, G. Vorlaufer, T. Dick, R. Jisa: Complex micromodel analysis of wearing contact interfaces, Proceedings/CD-ROM, World Tribology Conference 2005, Elsevier B.V., Washington DC (USA), 12.-16.09.2005, ISBN 0-7918-3767-X, Nr. 63540, 2005.

[7] T. Dick, S. Basseville, G. Cailletaud: Fatigue modelling in fretting contact with a crystal plasticity model, Computational Materials Science, Volume 43, Issue 1, July 2008, pp. 36-42.

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PhD Thesis, Paris 2006

Title:	Multiscale modelling of a blade/disk contact in aeroplane engines
Supervisor:	Prof. Georges Cailletaud
Institution:	Centre des Materiaux, Ecole des Mines de Paris

Abstract:

Blade-disc fixings in the fan of aeroplane turbo-engines are highly loaded form-closed connections that allow micrometer size relative movement between blade and disc. This loading type is called fretting, the encountered damage mechanisms are wear and cracking. To reduce damage, palliative coatings are applied. To assure the reliability of the engine these coatings need to be reapplied during regular maintenance operations. The prediction of wear and fissuration in the fixings is a challenging task. Better tools for damage prediction will allow an optimization of the maintenance intervals and the design of more damage resistant blade-disc fixings. The goal of this work is the construction of a finite element (FE) model that is suitable for an accurate prediction of fretting damage in blade-disc fixations. With this goal in mind, methods are elaborated to take (i) the change of the friction coefficient, (ii) cyclic plastic material deformation, (iii) crack initiation, (iv) wear and related contact geometry change and (v) wear-fissuration interaction into account. Integrating some of the models into a finite element analysis of the blade-disc contact, an attempt to predict wear and fatigue in a blade-disc fixation is made. To describe the change of the apparent friction coefficient during the wear of the coatings, analytical and FE models are made. In these the apparent friction coefficient is regarded to be the mean value of a micro-structurally heterogeneous contact. For the description of the cyclic plastic deformation of Ti6Al4V a multikinematic von Mises material model and a polycrystal plasticity material model is used. Both models are suitable for the description of ratchetting, additionally the polycrystal plasticity

model takes micro-scale plastic deformation, crystallographic texture and mean stress relaxation into account. Crack initiation is computed using the Dang Van high cycle fatigue criterion. For the use with polycrystal plasticity models the criterion is reassessed. As a wear criterion the dissipated energy approach is used. Contact geometry change by wear is taken into account in FE computations by iteratively updating the mesh by the computed wear. An attempt to describe the interaction of wear and fatigue is made using polycrystal plasticity and the Dang Van criterion in FE fretting computations with a cylinder-plate contact pair. The computations are compared to corresponding fretting experiments provided by partners from LTDS - Ecole Centrale de Lyon. Finally geometry change by wear, cyclic plastic deformation and fissuration of the blade-disc assembly are calculated in 2D and 3D FE computations. A main result is the circumstance that wear, fatigue and their interaction can be qualitatively described using a polycrystal plasticity material model and the Dang Van criterion without the use of a classical wear model. The fact that this is not possible with von Mises material models shows that replacing macro-scale phenomenological models by more physically based micro-scale models increases predictive power. In all FE computations with the blade-disc fixing including geometry change by wear and von Mises plasticity, wear increases fatigue life, cyclic plastic deformation can have the opposite effect. It is shown that a 2D simplification of the blade-disc model yields unrealistic results. This means that 3D modeling is indispensable. A macro-scale model for the prediction of wear and cracking in the blade-disc fixing has been constructed in this thesis. An integration of the micro-scale models developed in this thesis into the blade-disc fretting model will further increase the predictive power.

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Diploma Thesis, Leoben 2001

Title:	Measurement of local deformations of particle reinforced aluminum alloys
Supervisor:	Prof. Reinhard Pippan, Prof. Otmar Kolednik
Institution:	Erich Schmid Institut der Akademie der Wissenschaften, Montanuniversität Leoben

Abstract:

Local deformations of particle reinforced aluminum alloys were investigated by stereophotogrammetric deformation measurement by means of an in-situ tensile test in a scanning electron microscope. With this method the inhomogeneous deformation of the matrix around reinforcing particles could be observed. In order to get appropriately decorated specimen surfaces, suitable preparation methods had to be developed. Two Materials which consisted of a matrix of the aluminum alloy A6061 and contained 10 percent reinforcing particles of silicon carbide were tested. They were produced by employing a powder metallurgical technique and differed in the size of the reinforcing particles which was 100 µm and 10 µm. In the material with a particle size of 100µm, which had a ultimate strain of only 1 percent, the deformation in the matrix was very localized at fractured particles. In the material with a particle size of 10 µm, which had a ultimate strain of 6 percent, shear bands were formed. A good agreement between presented experimental results and finite elements calculations from other investigations was revealed.

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Bachelor of Engineering Thesis, Moscow 1999

Title:	Determination of structural parameters and developing route for the manufacturing of a toroidal two layer metal – composite pressure tank for the application as a respiration apparatus
Supervisor:	Prof V. A. Tarasov
Institution:	Department of Space Machinery Production Techniques, Special Machinery Engineering Faculty, Bauman Moscow State Technical University