PROGRAM GUIDE & SCHEDULE

2011 International Joint Tribology Conference

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10:30 – 11am
An Elastic-plastic Spherical Contact Model Under Combined Normal and Tangential Loading
2-3 Page Paper. IJTC2011-61126
***Aizhong Wu, Xi Shi**, Shanghai Jiao Tong University, Shanghai, China, **Andreas A. Polycarpou**, University of Illinois at Urbana-Champaign, Urbana, IL, United States*
In this work, by utilizing the shear strength criterion for the sliding inception, a finite element model for obliquely loaded spherical contact has been developed, which realized a friction transition from perfect slip case to full stick case with increasing normal approach. Both tangential force and normal force during tangential loading were investigated using different models. It was found that with elastic-plastic normal displacement preload, there is an obvious normal force release during tangential loading. Furthermore, both Coulomb friction model and the proposed model predict a lower tangential force at the same tangential displacement compared to the full stick model. However, the Coulomb friction is more empirically determined with some arbitrary friction coefficient whereas the proposed model is based on physics parameters.

11 – 11:30am
A Multiscale Approach for Damage of Biphasic Composite Under Tribological Solicitations
Technical Presentation Only. IJTC2011-61130
***Matthieu Champagne**, **Mathieu Renouf, Coumba Mbodj,** LAMCOS - INSA Lyon, Villeurbanne, France (Metro), **Yves Berthier**, Université de Lyon, CNRS, Villeurbanne, France*
Behaviour of biphasic composite (seen as a matrix with a distribution of heterogeneous inclusions) under homogeneous solicitations is yet well understood, but it is not the case under tribological solicitations (pressure and shear velocity), especially when one try to model damage mechanisms in the composite's structure. To make a step forward in such understanding, a multiscale approach based on a combination of both finite (FEM) and discrete (DEM) element methods is used. In particular, one focuses on cracks mechanisms and decohesion at the fibre/matrix interface: the "local discontinuous" model (collection of rigid bodies) is used to investigate the local behaviour of the structure while the "global discontinuous" model (collection of deformable bodies) is used to connect the fissuration between the different inclusions.

11:30am - Noon
New Steps Toward Understanding Squat Defect
Technical Presentation Only. IJTC2011-61151
***Samuel Simon, Yves Berthier**, Université de Lyon, CNRS, Villeurbanne, France (Metro), **Aurélien SAULOT**, LaMCoS, INSA-Lyon, CNRS, Université de Lyon, Villeurbanne, France, **Xavier Quost**, RATP, Fontenay-Sous-Bois, France*
Nowadays squats have become one of the major rolling contact fatigue defect on some railway networks. Several studies deal with squat defect but most are mainly focused on crack growth from a metallurgical point of view. However root causes responsible for crack initiation are still unknown and need to be clarified to understand the whole damage mechanism.
Two studies have been conducted to supplement the standard characterization of squat. On one hand a tribological extensive investigation has been performed on samples of light squats from various areas. Surfaces and cross-sections of rail samples have been observed by optical microscopy and scanning electronic microscopy. On the other hand a milling test has been performed on a large sample of squats in the field with a milling train and in laboratory. More than 500 squats were thereby located and taken in picture after each material removal.
These studies provide new information to understand damage mechanism from initiation to propagation. Tribological observations highlight the running band is composed of longitudinal contact strips with various surface and subsurface morphologies. This microstructure seems to be essential to initiate a squat. Milling test gives us a volume picture of the cracks network in the bulk material which extends classic 2D views and enables us to carry out a statistical study between surface aspect of squat and crack depth.

3F - TRACK 12 Symposium on Particle Tribology
Track Chair: **C. Fred Higgs III**, *Carnegie Mellon University, Pittsburgh, PA, United States*

12-1 -PARTICLE TRIBOLOGY
8:30am – Noon – Grand 4
Session Chair: **Kurt Beschorner**, *University of Wisconsin-Milwaukee, Milwaukee, WI, United States*

8:30 – 9am
The Influence of Sand Particle Properties on Abrasive Wear Behaviour
Technical Presentation Only. IJTC2011-61056
***Martijn Woldman, E. van der Heide, D.J. Schipper**, **M.A. Masen,** University of Twente, Enschede, Netherlands, **T. Tinga**, Netherlands Defence Academy, Den Helder, Netherlands*
For machines operating in a sandy environment such as a desert, the mechanism of abrasion is a main factor leading to excessive wear. Sand particles may enter a machine and become entrapped between moving surfaces. This leads to abrasive wear and, ultimately, failure of the system. In order to prevent failure, knowledge of the abrasive wear process is required, quantified by the wear rate. With this knowledge, maintenance can be planned and performed, thereby reducing downtime and failure of machinery.
Sand was selected from several locations around the world, with variations in e.g. particle size, shape and hardness. The wear behaviour was investigated by performing dry sand-rubber wheel tests with the varieties of sand on St-52 samples. The sand particles were sieved to determine their size range. Using a confocal microscope the particle shape was characterized and mechanical properties such as hardness were determined by performing nano-indentations. To establish the sands composition and verify its hardness, EDS analyses were carried out. The experimental results show a significant difference in the wear behaviour of the sand varieties tested. The results provide input for a future quantitative model based on [1], describing the wear of systems operating in abrasive environments.
[1] MA Masen, MB De Rooij, DJ Schipper, (2005), Micro-contact based modelling of abrasive wear, Wear, 258 (1-4 SPEC. ISS.), 339-348

9 – 9:30am
On Cohesion of Micron Scale Metal Particles in High Velocity Impact with a Metal Substrate
2-3 Page Paper. IJTC2011-61084
***Baran Yildirim, Sinan Muftu, Andrew Gouldstone**, Northeastern University, Boston, MA, United States*
For impact of a particle, elastic strain energy stored in particle and substrate causes particle to rebound after reaching the point of maximum compression. Rebound energy of the particle can be predicted by finite element simulations. However, at high velocities,