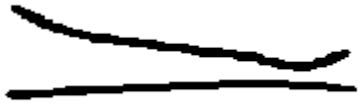
Proceedings of VAREHD Conference

Vol. 15, 2010



ISSN 1844-8917

"Stefan cel Mare" University of Suceava Publishing House

Suceava, 2010

Scientific committee

Dr. Yves BERTHIER, INSA de Lyon, FRANCE

Prof. Traian CICONE, Polytechnic University of Bucharest, ROMANIA

Prof. Spiridon CREȚU, Technical University of Iasi, ROMANIA

Prof. Ion CRUDU, University of Galati, ROMANIA

Prof. Emanuel DIACONESCU, University of Suceava, ROMANIA

Prof. Valeriu DULGHERU, Technical University of Moldova, MOLDOVA

Prof. Marilena GLOVNEA, University of Suceava, ROMANIA

Dr. Romeo GLOVNEA, University of Sussex, UNITED KINGDOM

Prof. Branko IVKOVIC, University of Kragujevac, SERBIA

Prof. Ilie MUSCĂ, University of Suceava, ROMANIA

Prof. Ioan NICOARĂ, Polytechnic University of Timisoara, ROMANIA

Prof. Dumitru OLARU, Technical University of Iasi, ROMANIA

Prof. Mircea PASCOVICI, Polytechnic University of Bucharest, ROMANIA

Prof. Dumitru POP, Technical University of Cluj-Napoca, ROMANIA

Prof. Minodora RÎPĂ, University of Galati, ROMANIA

Prof. Andrei TUDOR, Polytechnic University of Bucharest, ROMANIA

Contact Mechanics

6. NUMERICAL SIMULATION OF ELASTIC-PLASTIC CONTACT

by Sergiu SPINU

University "Stefan cel Mare" of Suceava, Romania

Abstract: *A fast algorithm for elastic-plastic non-conforming contact simulation is presented in this paper. The plastic strain increment is determined using an universal integration algorithm for isotropic elastoplasticity proposed by Fotiu and Nemat-Nasser. Elastic-plastic normal contact problem is solved iteratively based on the relation between pressure distribution and plastic strain, until the latter converges. The contact between a rigid sphere and an elastic-plastic half-space is modeled using the newly proposed computer program. Numerical simulations predict that residual stresses decrease the peak intensity of the stresses induced by contact pressure, thus impeding further plastic flow. Computed pressure distributions appear flattened compared to elastic case, due to changes in both hardening state of the elastic-plastic softer material and contact conformity.*

7. RESIDUAL STRESSES IN ELASTIC-PLASTIC CONTACT PROBLEM

by Sergiu SPINU & Dorin GRADINARU

University "Stefan cel Mare" of Suceava, Romania

Abstract: *A fast algorithm to predict residual stresses related to development of plastic strain in elastic-plastic contact is advanced in this paper. The plastic zone is partitioned in a set of cuboids of uniform strains, and solutions for each individual cuboid, derived by Chiu in closed form expressions, are superimposed. Computation is accelerated by implementing three-dimensional spectral methods, in a hybrid convolution-correlation algorithm. Pressure-free boundary condition is imposed with the aid of Boussinesq formulas and superposition principle, resulting in increased computational efficiency. Predictions of residual stresses due to a spherical plastic zone are compared with existing analytical and/or numerical results, and a good agreement is found.*

8. PRELIMINARY THEORETICAL RESULTS UPON CONTACT PRESSURE ASESSMENT BY AID OF REFLECTIVITY

pp. 19-27

by Cornel SUCIU & Emanuel DIACONESCU

Department of Mechanical Engineering, University of Suceava, Romania

***Abstract**: Several different experimental methods for investigating contact features can be found in literature. The idea to optically investigate the surfaces of contacting bodies [1-8], led to the development of a new technique to measure the pressure distributions in a real contact [9-11].*

One of the contacting surfaces is covered, prior to contact establishment, by a special gel. The contact closing removes the excess gel and, during a certain time interval, the contact pressure transforms the entrapped substance in an amorphous solid. In each point, the refractive index of this solid depends on the pressure acting during transformation. After contact opening, the reflectivity of this coating depends on the former contact pressure and it is mapped by aid of a laser profilometer, thus becoming an indicator of contact pressure.

This paper studies the effect of pressure on the refractive index of the solidified gel layer, as well as the different parameters that influence its reflectivity. Using molecular physics and optics, a theoretical model of reflectivity is studied and it is found to be strongly influenced by both pressure and gel layer thickness. From this model, pressure distribution laws are found for different ranges of reflectivity and gel layer thickness.

9. A NUMERICAL PROCEDURE TO GENERATE NON-GAUSSIAN ROUGH SURFACES

pp. 1-8

by Ana Urzică & Spiridon Creţu

Department of Machine Design, Technical University of Iaşi, ROMANIA

***Abstract**: The paper presents an algorithm for computer simulation of non-Gaussian surfaces. By using a random number generator a input matrix is formed as a first representation of a Gaussian roughness with zero mean, and unit standard deviation. The autocorrelation function was assumed to have an exponential form. To fulfill this requirement, in the first step, the matrix containing the roughness heights was obtained by a linear transformation of the input matrix. In the second step the skewness and kurtosis of the input sequence have been established for the desired skewness and kurtosis of an output sequence. Finally the non-Gaussian random series have been generated by using the Johnson translator system. The numerical results pointed out that the developed algorithm can be further used to simulate manufacturing processes that produce real surfaces which may present a non-Gaussian distribution, as well as the abrasive wear and running in phenomena.*

Biotribology

mechanical and tribological stability of the studied bilayers. In ultrapure water, bilayers obtained by the micelle method are not resistant and spontaneously adsorb to the other contacting surface. Bilayers prepared by the vesicle method show slightly better lubricant properties than those prepared by the micelle method. Additional salt (150 mM NaCl) has existing but secondary effects on the mechanical and tribological properties of the bilayers.

12. PHOSPHOLIPIDES DANS LE FLUID SYNOVIAL - INFLUENCE SUR LE FONCTIONNNEMENT TRIBOLOGIQUE DES ARTICULATIONS SYNOVIALES PATHOLOGIQUES

by M.C. Corneci[1,2], A.-M. Trunfio-Sfarghiu[1], F. Dekkiche[3,4], Y. Berthier[1], M.-H. Meurisse[1], J.-P. Rieu[3], M. Lagarde[5] & M. Guichardant[5]

[1] Laboratoire de Mécanique des Contacts et des Structures, INSA-Lyon, CNRS UMR5259, F69621 Villeurbanne Cedex, FRANCE ,

[2] Université Technique "Gh. Asachi", Faculté de Mécanique, 700050, Iasi, Roumanie

[3] Laboratoire de Physique de la Matière Condensée et Nanostructures, Université Claude Bernard Lyon 1, CNRS UMR5586, F69622 Villeurbanne Cedex, France

[4] Département de Chimie, Faculté de Sciences exactes. Université Mentouri Constantine (25000), Algérie

[5] Institut Multidisciplinaire de Biochimie des Lipides, INSERM / INSA de Lyon, UMR870, F69621, Villeurbanne, France

***Abstract**: Des études récentes ont montré le rôle des assemblages lipidiques associées à la structure discontinue du fluide synovial dans les performances du fonctionnement tribologique d'une articulation saine. Dans le cas des pathologies articulaire, ce fonctionnement est modifié. Ce travail cherche ainsi à identifier l'influence de la variation en composition lipidique des fluides synoviaux pathologiques sur le fonctionnement tribologique des articulations synoviales atteintes de différentes pathologies (arthrite, arthrose).*

13. MICRODEFECTS ANALYSIS OF DENTAL CONTACT SURFACES

by Gheorghe FRUNZA[1], Mihai Catalin FRUNZA[2] & Cornel SUCIU[1]

[1]*University of Suceava, Romania, Faculty of Mechanical Engineering, Mechatronics and Management*

[2]*University of Medicine and Pharmacy, Bucharest, Romania, Faculty of Dental Medicine*

***Abstract**: The tribological processes influence the behaviour of the biocontacts between biological bodies, between biomaterials, or between biological bodies and biomaterials. Whether natural or*

artificial, any biocontact is the locus of biophysical, biochemical, and metabolic mechanisms taking place on both the molecular and the supramolecular levels. The first mechanism is influenced by biomechanical and bioelectric changes, the second comprises biochemical reactions that depend on the nature of interface materials, and the third manifests itself by the action of the enzymes that hold the potential of degrading all components of the extracellular matrix. These mechanisms mutually interact and may yield complex interface phenomena within the stomatognatic system.

This paper presents a tribological model concerning dental contacts deterioration, based on contact mechanics elements, fracture mechanics and on the actual topography of the tooth surface.

14. IMAGERIE MEDICALE POUR EVALUER LES CONDITIONS DU FONCTIONNEMENT TRIBOLOGIQUES DES ARTICULATIONS SYNOVIALES

pp. 137-149

by Simon LE FLOC'H[1,2] , M.C. Corneci[2,3] , A.-M. Trunfio-Sfarghiu[2] ,M.-H. Meurisse[2] J.-P. Rieu[4] , J. Duhamel[2] , C. Dayot [2] , F. Dang[2] , M. Bouvier [2], C. Godeau [2], A. Saulot [2] , Y. Berthier

[1]Université Joseph Fourier, Ecole doctorale EDISCE, Laboratory TIMC-IMAG, DynaCell Team, FRANCE

[2]Laboratoire de Mécanique des Contacts et des Structures, INSA-Lyon, CNRS UMR5259, F69621 Villeurbanne Cedex, FRANCE

[3]Université Technique "Gh. Asachi", Faculté de Mécanique, 700050, Iasi, Roumanie

[4]Laboratoire de Physique de la Matière Condensée et Nanostructures, Université Claude Bernard Lyon 1, CNRS UMR5586, F69622 Villeurbanne Cedex, France

***Abstract**: Le but de ce travail est d'évaluer avec précision les conditions tribologiques macroscopiques subies par l'articulation du genou au cours de la marche en essayant de considérer les interactions entre elles ; Le contexte plus global est la compréhension du fonctionnement tribologique de l'articulation saine lui permettant de durer 70 ans. Dans une première partie, les vitesses relatives tangentielles entre les surfaces en contact ont été évaluées au cours de la marche. L'étude a été consacrée aussi à l'évaluation des conditions géométriques du contact lorsque le pied subit un effort de compression de l'ordre de 300 N (patiente de 29 ans pesant 60 kg ayant subi une méniscotomie). Les résultats sur la déformée sont validés qualitativement par des éléments bibliographiques. Ils permettent d'émettre une hypothèse quant à la capacité du cartilage à se déformer de quelques dixièmes de mm suivant son épaisseur sans que la pression locale de contact soit importante, permettant une répartition de la pression très efficace. L'étude a été complétée par l'évaluation de l'influence des efforts musculaires sur la réaction de contact et sur les déplacements relatifs des os (patient de 36 ans et de 62 kg (avec une lésion des ménisques) a subi une compression du membre inférieur). Il est conclu que l'action des muscles augmente énormément la pression moyenne de contact, mais que cette action peut aussi permettre d'optimiser les conditions de contact en déplaçant le tibia par rapport au fémur.*

15. ANALYSE MECANIQUE ET PHYSICO-CHIMIQUE MULTIECHELLE DU FONCTIONNEMENT TRIBOLOGIQUE DES IMPLANTS ORTHOPEDIQUES

pp. 150-162

by A.M. Trunfio-Sfarghiu[1] , M.C. Corneci[1,2], Y. Berthier[1], M.H. Meurisse[1] & J.P. Rieu[3]

[1]Laboratoire de Mécanique des Contacts et des Structures, INSA-Lyon, CNRS UMR5259, F69621 Villeurbanne Cedex, FRANCE

[2]Université Technique "Gh. Asachi", Faculté de Mécanique, 700050, Iasi, Roumanie

[3]Laboratoire de Physique de la Matière Condensée et Nanostructures, Université Claude Bernard Lyon 1, CNRS UMR5586, F69622 Villeurbanne Cedex, France

***Abstract**: The aim of this work is to identify the coupled role of the biological components of synovial fluid in the remarkable tribological operation of a healthy natural joint, as well as in the friction of steel and polythene implants. It uses a realistic ex-vivo model capable of reproducing the mechanical and physicochemical characteristics of the entire tribological triplet of the joint, whether healthy or implanted. It particularly focuses on the lipidic bilayers and vesicle structures associated with synovial fluid. The analysis of the friction measurements and fluorescence microscopy images confirm the role of lipidic bilayers in maintaining a very low friction coefficient. In addition, we observe that the substitute cartilage favours the formation and maintenance of these bilayers, which is not the case of implant materials.*

16. A WEAR MODEL OF UHMWPE IN HUMAN PROSTHESIS

pp. 112-121

by Andrei TUDOR, Georgiana CHISIU & Alina POPESCU

Polytechnic University of Bucharest, Romania

***Abstract**: The wear rate of ultra-high molecular polyethylene (UHMWPE) total joint prosthesis is known to be influenced by various factors such as material and design. However, it is not known if these factors affect the size or morphology of the wear particles. A theoretical model of wear particle that is based of intimate conical asperity with spherical tape and prismatic asperity with cylindrical tape interactions are proposed to account for the observed differences in sliding and rolling wear. Archard's wear coefficient has determined for plastic contact of UHMWPE with the rigid asperity of biocompatible steel used in the prosthesis.*

Friction and Wear

20. ABOUT A „TRIBOLOGICAL PASSPORT" OF WHEEL-RAIL CONTACT IN METRO SYSTEM

by Andrei TUDOR[1], Nicolae SANDU[2] & Ilias TOUNTAS[3]

[1]Polytechnic University of Bucharest, Romania

[2]Romanian Authority of Rail Way, Bucharest, Romania, [3]Attiko Metro A.E. Athena, Greece

***Abstract**: The adhesion coefficient in the rail-wheel contact is known to be influenced by various factors such as material and longitudinal creepage, contact pressure and environmental conditions (dry, contaminated contact with water or hydraulic oil). The adhesion map contains the friction coefficients which are represented as a function of the relative longitudinal sliding velocity and the contact pressure. Dimensionless contact pressure is defined as the ratio of the hertzian contact pressure and the minimum contact surface hardness. The experimental results of adhesion coefficient obtained by the Amsler friction and wear machine are fitted by analytical curves (parabola and line).*

21. AN ANALYTICAL WEAR MODEL OF THE PIPES FOR CONCRETE TRANSPORTATION

by Monica VLASE[1] &Andrei TUDOR[2]

[1]Technical University of Civil Engineering of Bucharest, Romania

[2]University POLITEHNICA of Bucharest, Romania

***Abstract**: The flow of fresh concrete in the pipe can be realized only when the concrete is saturated. The tribological solutions are formulate to obtained the saturation of concrete. The effect of flow in pipe is evaluated by the friction with the wall and the pipe wear. It is defined a critical angle of concrete impact in transition between horizontal and vertical pipe as a function to the friction coefficient, the velocity and the mean radius of solid particle in fresh concrete. The erosion wear model is proposed for inside of pipe in contact with concrete.*

Rheology

22. INFLUENCE OF NANOPARTICLES ON LUBRICITY OF BASE MINERAL OIL

by Juozas Padgurskas[1], Raimondas Kreivaitis[1], Arturas Kupčinskas[1], Raimundas Rukuiža[1], Vytenis Jankauskas[1] & Igoris Prosyčevas [2]

[1]*Department of Mechanical Engineering* Lithuanian University of Agriculture – Kaunas, Lithuania

[2]*Institute of Physical Electronics,* Kaunas University of Technology – Kaunas, Lithuania

***Abstract**: The tribological properties of mineral oil SAE 10 modified with metallic nanoparticles were investigated. The tribological tests were performed using four-ball test rig. Friction and wear reduction properties were measured. There was observed the positive influence of nanoparticles on lubricity of mineral oil. The best result was obtained when using the copper nanoparticles for a single metal nanosuspension (0.25 % Cu). Using double metal nanoparticles the best result show iron – copper nanosuspension (0.125 % Fe + 0.125 % Cu). The use of those suspensions was most efficient for pure base mineral oil. The cobalt nanosuspension does not show the significant increase in lubricity. It was observed that nanosuspensions stabilise and decrease the friction during the tests.*

23. INFLUENCE OF THE RHEOMETER GEOMETRY ON THE RHEOLOGICAL PROPERTIES OF INDUSTRIAL LUBRICANTS

by Alexandru V. Radulescu[1] & Irina Radulescu[2]

[1]*Department of Machine Elements and Tribology,* University POLITEHNICA Bucharest, Romania

[2]Mechanical Engineering and Research Institute S. C. ICTCM S.A. Bucharest, Romania

***Abstract**: The rheological properties of two transmission lubricants (75W90 and 75W140), in fresh and used state, were investigated using shear viscosity rheological measurements. It was found that the lubricants do not exhibit a yield stress and that, above a critical shear rate, they exhibit shear-thinning behaviour, well described by the Cross model. The rheological measurements were performed on a Brookfield viscometer CAP2000+ equipped with four cone-and-plate geometry, for a range of temperature between 20 … 70°C, using the viscometer Peltier system. The experiments have shown that only two geometries are appropriate for testing the transmission lubricants. Another important conclusion refers to the influence of the wear degree of the lubricant on the rheological parameter of the model.*

24. MEASUREMENT OF LUBRICANT OIL MICROVISCOSITY BASED ON RESONANT FREQUENCY SHIFT OF AFM CANTILEVER

pp. 86-91

by Vlad Flaviu ZEGREAN & Emanuel DIACONESCU

Department of Applied Mechanics University "Stefan cel Mare" of Suceava, Romania

***Abstract**: Experimental investigations on microviscosity of T90 lubricant oil were conducted using an atomic force microscope. The resonant frequency of the cantilever beams was measured in air, in pure water and in sample oil. Based on the resonant frequency shift the viscosity of the lubricant was calculated using the formula deducted by Papi [1] for uncalibrated cantilevers. The results obtained are in good agreement with those of Ionescu [2], measured with a Rheotest2 rheometer, for the same lubricant.*

PhD Students

26. RESEARCH ISSUES ON PUNCH – CIRCULAR PLATE ELASTIC CONTACTS

pp. 213-221

by Marius TRANDAFIR & Emanuel Diaconescu

Department of Mechanical Engineering, University of Suceava, Romania

***Abstract**: Circular plates enter into category of finite dimension bodies. Solutions regarding the displacements and stresses which appear at the contact involving finite dimension bodies and also numerical and analytical results regarding some plate were reviewed in this study. For thin bodies and small transversal dimension bodies Diaconescu and Glovnea [1], [2] advanced analytical solutions solving a Boussinesq type problem for a elastic layer and a Boussinesq type problem for a cylindrical body. The obtained results satisfy all elasticity requirements so they are the searched ones. Experimental set-ups build by Glovnea [3] and Ovcharenko [4], used to investigate contact problems via laser profilometry or direct optical methods were also reviewed.*