11th World Congress on Computational Mechanics (WCCM XI)
5th European Conference on Computational Mechanics (ECCM V)
6th European Conference on Computational Fluid Dynamics (ECFD VI)
July 20–25, 2014, Barcelona, Spain

ABOUT THE MOVEMENT OF A SOLID BODY ON A PLANE SURFACE IN ACCORDANCE WITH ELLIPTIC CONTACT AREA AND ANISOTROPIC FRICTION

Nikita N. Dmitriev[1], **Olga A. Silantyeva**[2*]

[1]Dep. Mathematics and Mechanics, Saint-Petersburg State University, 198504, Russia, Saint-Petersburg, Peterhof, Universitetski pr.28., dn7@rambler.ru
[2]Dep. Mathematics and Mechanics, Saint-Petersburg State University, 198504, Russia, Saint-Petersburg, Peterhof, Universitetski pr.28., olga.silantyeva@gmail.com

Key words: *anisotropic friction, elliptical contact area, finite movement.*

We examine inertial finite movement of a thin body on a plane surface. The contact area has an elliptical shape and the friction is anisotropic (properties vary with direction of sliding). Summarising the results of [1] and [2], we assume the following expression for friction force law:

$$\vec{T} = -N\mathcal{F}(M)\frac{\vec{v}}{|\vec{v}|}, \mathcal{F}(M) = \begin{pmatrix} f_x & f \\ -f & f_y \end{pmatrix},$$

where $\vec{T}$ – friction force vector, N – normal pressure, $\mathcal{F}(M)$ – friction tensor, $\vec{v}$ – velocity vector, f_x, f_y, f – frictional coefficients.

The research deals with friction force and moment interrelations. We study the body movement in numerical experiments. Equations of motion are developed and simplified in accordance with the form of contact area and frictional anisotropy. Sliding and spinning finish at the same moment like in the case of circle contact area (see [3], [4]). Distances from body center to the instantaneous velocity center were calculated for several frictional factors and some stop positions. We also investigated evolution of movement parameters with respect to ellipse eccentricity and analysed normal and tangential forces during the process.

We formulated and solved problems for several simple laws of pressure distribution (uniform and linear laws with respect to elliptical area are presented on the picture). We used solutions for circle contact area (see [4], [5]) for comparison and simulations correction. All situations are examined for number of friction coefficients and ellipse eccentricities.

Our results are suitable for more precise calculation of anisotropic friction forces in the elliptical contact area with variations in pressure distribution (for example, railway contact problems).

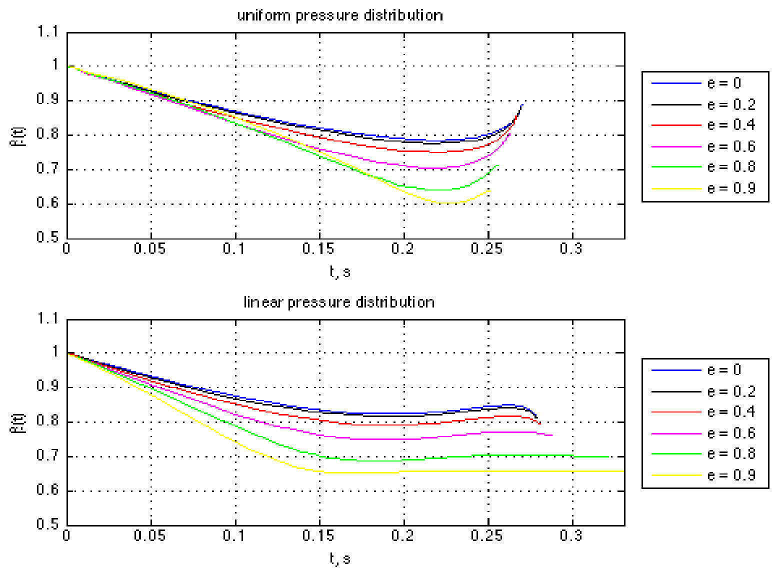

Figure 1: Evolution of parameter $\beta = \frac{v}{\omega}$ according to ellipse properties and friction coefficient $\mu = 0.18$ ($\mu = f_y - f_x$)

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