

Koroleva Y. O., Korolev A.V. (Moscow, Russia) – On a hydrodynamic problem in a domain with random roughness.

We study three-dimensional incompressible flow of lubricant in a domain bounded by two moving surfaces $x_3 = \varepsilon h^\pm(x_1, x_2, t)$, $(x_1, x_2) \in \omega, t \in [0, T]$ with a rough random structure. It is assumed that parameter $\varepsilon > 0$ characterizes the thickness of the gap between the surfaces. The roughness of the surfaces is assumed to be an ergodic stochastic process, thus pressure is also a stochastic process. We rigorously derive the stochastic Reynolds equation which describes pressure of the lubricant in the limit as $\varepsilon \rightarrow 0$:

$$D_t h + \operatorname{div} \left(-\frac{h^3}{12\nu} \nabla p^* + \frac{h}{2}(v^+ + v^-) \right) = 0 \quad \text{in } \omega \times (0, T) \quad (1)$$

Here ν is the viscosity of lubricant, v^\pm are given velocities of the surfaces, $h \equiv h^+ - h^- = h_0 + h_s$, h_0 is a film thickness corresponding to smooth surfaces while term h_s describes the roughness of the surfaces and is assumed to be a randomly varying field of mean 0.

The obtained result generalizes an analysis of a similar lubrication problem in a domain with a smooth deterministic boundary, see [1],[2].

REFERENCES

1. *J. Fabricius, Y. Koroleva and P. Wall*, A rigorous derivation of the time-dependent Reynolds equation, *Asympt. Anal.*, 2013, vol. 84, № 1–2, pp. 103–121.
2. *J. Fabricius, Y. Koroleva and P. Wall*, Asymptotic behavior of Stokes flow in a thin domain with a moving rough boundary, *Proc. R. Soc. A*, 2014, vol. 470, №2167, 20130735, 21 p.