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# MODELING SOLID CONTACT BETWEEN SMOOTH AND ROUGH SURFACES WITH NON-GAUSSIAN DISTRIBUTIONS

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## MOTIVATION

High accuracy of prediction is required for solid contact calculation in mixed lubrication to predict friction loss or wear in sliding parts. In general, the solid contact is calculated by the Greenwood-Williamson model [1] or the Greenwood-Tripp model [2]. But it is not possible to take into account the distribution bias (ex. skewness and kurtosis) that exists on many sliding surfaces in these models, so there is a possibility of causing a deviation from an actual phenomenon. In this study, in order to calculate the solid contact of the rough surface assuming the actual sliding surface, we constructed a model capable of predicting the asperity height distribution by the value of skewness and kurtosis. By using this model, it is possible to predict its distribution shape separately without measuring the height distribution of protrusions.

## ASPERITY HEIGHT DISTRIBUTION

Assuming that the asperity height distribution is similarly transformed when the roughness distribution is converted from the Gaussian distribution to the non-Gaussian distribution, the asperity height distribution in the no-Gaussian rough surface is derived analytically (Fig.1). By using the Johnson distribution model [3] as a non-Gaussian distribution, it becomes possible to handle various the asperity height distributions as mathematical expressions. Calculating this model distribution by measured roughness parameters, despite the fact that the skewness and kurtosis are far away from the Gaussian distribution, the distribution tendency is also in good agreement with the asperity height distribution of measured surfaces.

## CONTACT CALCULATION

We applied this asperity distribution model to the Greenwood - Williamson model, and a predicted contact area and contact force. Although the increasing tendency of these with respect to the film thickness ratio greatly varies depending on the skewness and the kurtosis, the predicted values by this model are in good agreement with the results of the large scale direct calculation (Fig.2). We also calculated the mean real contact pressure (the ratio of the contact pressure and the real contact area) for each skewness and kurtosis, and confirmed that its absolute value and change tendency with respect to the film thickness ratio is greatly different. This fact seems to suggest that the tendency of friction or wear characteristics varies depending on kurtosis and skewness.

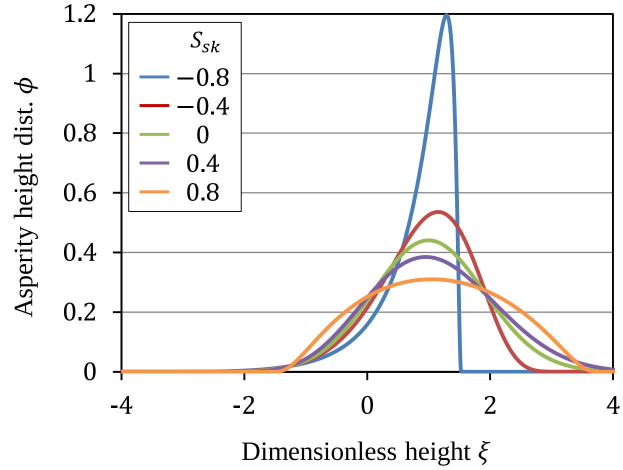


Fig.1 Asperity height distributions for different skewness

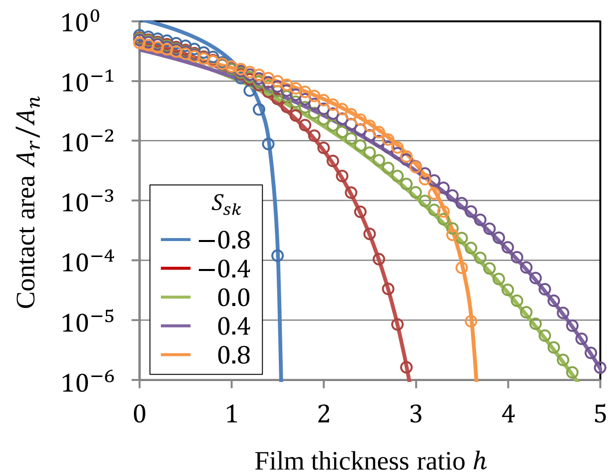


Fig.2 Contact areas under plastic deformation for different skewness(lines: present model, points: theoretical solutions)

## REFERENCES

[1] Greenwood, J. A. and Williamson, J. P., Proc. Roy. Soc. London A, 295, 1442, 1966, 300-319.
[2] Greenwood, J. A. and Tripp, J. H., Proc. Inst. Mech. Eng., 185, 1, 1970, 625-633.
[3] Elderton, W. P., and Johnson, N. L., Systems of frequency curves. Cambridge University Press, 1969.