NUMERICAL SIMULATION OF HYDRODYNAMIC LUBRICATION
BY SMOOTHED PARTICLE HYDRODYNAMICS METHOD

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ABSTRACT
Smoothed particle hydrodynamics method (SPH) method allows us to treat fluid flow with large deformation of liquid-air boundary, fragmentations and collision with solid wall.

Boundary conditions are required to solve Reynolds’ equation for hydrodynamics lubrication. Especially, oil film rupture at the outlet of lubricated area has been an intense subject of interest [1]. It is difficult to know exactly the position at which oil film rupture will occur and the pressure in the area of oil film rupture [2].

To avoid the problems with boundary conditions, we applied SPH to the hydrodynamic lubrication. Time evolution of oil film profile can be obtained. Film rupture spontaneously develops at the outlet.

METHOD
The classical geometry of hydrodynamic lubrication shown in Fig. 1 is simulated. The motion of an incompressible fluid is governed by the Navier-Stokes equations,

$$\frac{Du}{Dt} = -\frac{1}{\rho} \nabla p + \frac{\eta}{\rho} \nabla^2 u + F_{ST}$$

Surface tension is incorporated as a body force $F_{ST}$. According to the Akinci’s model, $F_{ST}$ is a combination of inter particle forces and forces based on surface curvature [3]. Calculating method for vector operators in Navier-Stokes equation and solid wall boundary condition are same as Adami’s way [4].

Numerical models is computed using the same operating conditions as described in the literature (Fig.3(a) in ref. [1]).

RESULTS
Figure 2 shows a snapshot and pressure profile. Positive pressure by SPH agrees with solution of Reynolds eq.. Fluctuation in outer region is attributed to surface tension model.

REFERENCES