Next Generation Automobiles in Miyagi

International Conference "Global/Local Innovations for Next Generation Automobiles"

Innovations for Next Generation Automobiles: Contribution of tribology

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TOTAL
COMMITTED TO BETTER ENERGY

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New Industry Creation Hatchery Center

TOHOKU UNIVERSITY

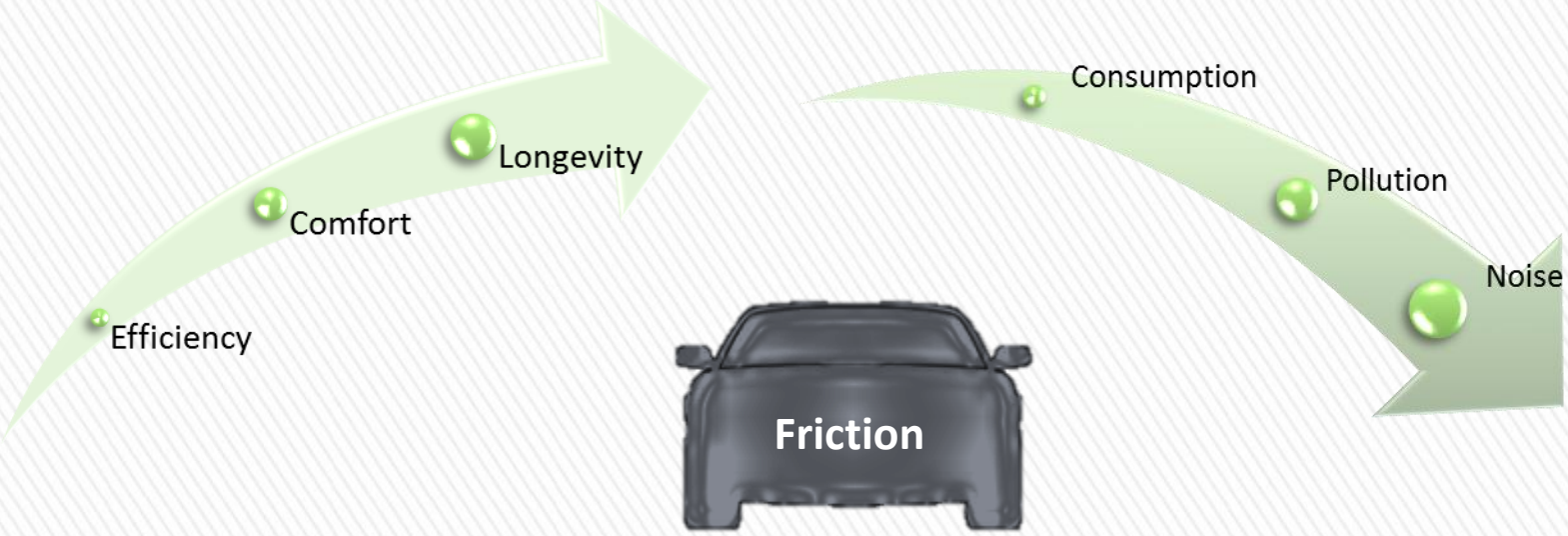
Car evolutions over the years

1771

1886

1950

Nowadays



Downsizing

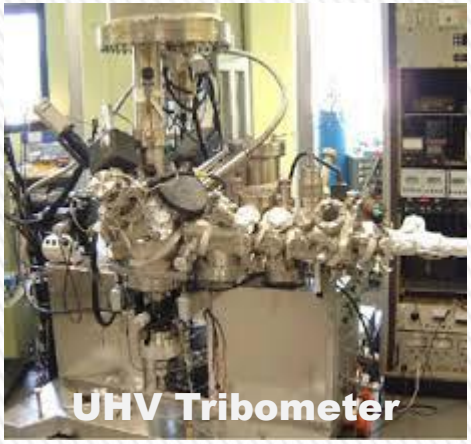
Reduce size while maintaining the power

Reduce engine size:

➔reduce the consumption of cars

➔ reduce pollution emissions

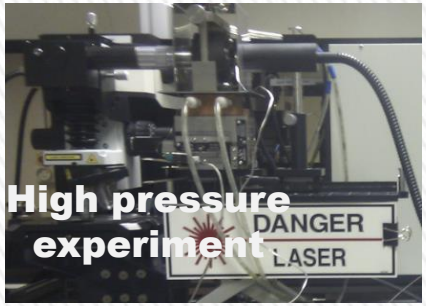
Tribological challenges



Tribology

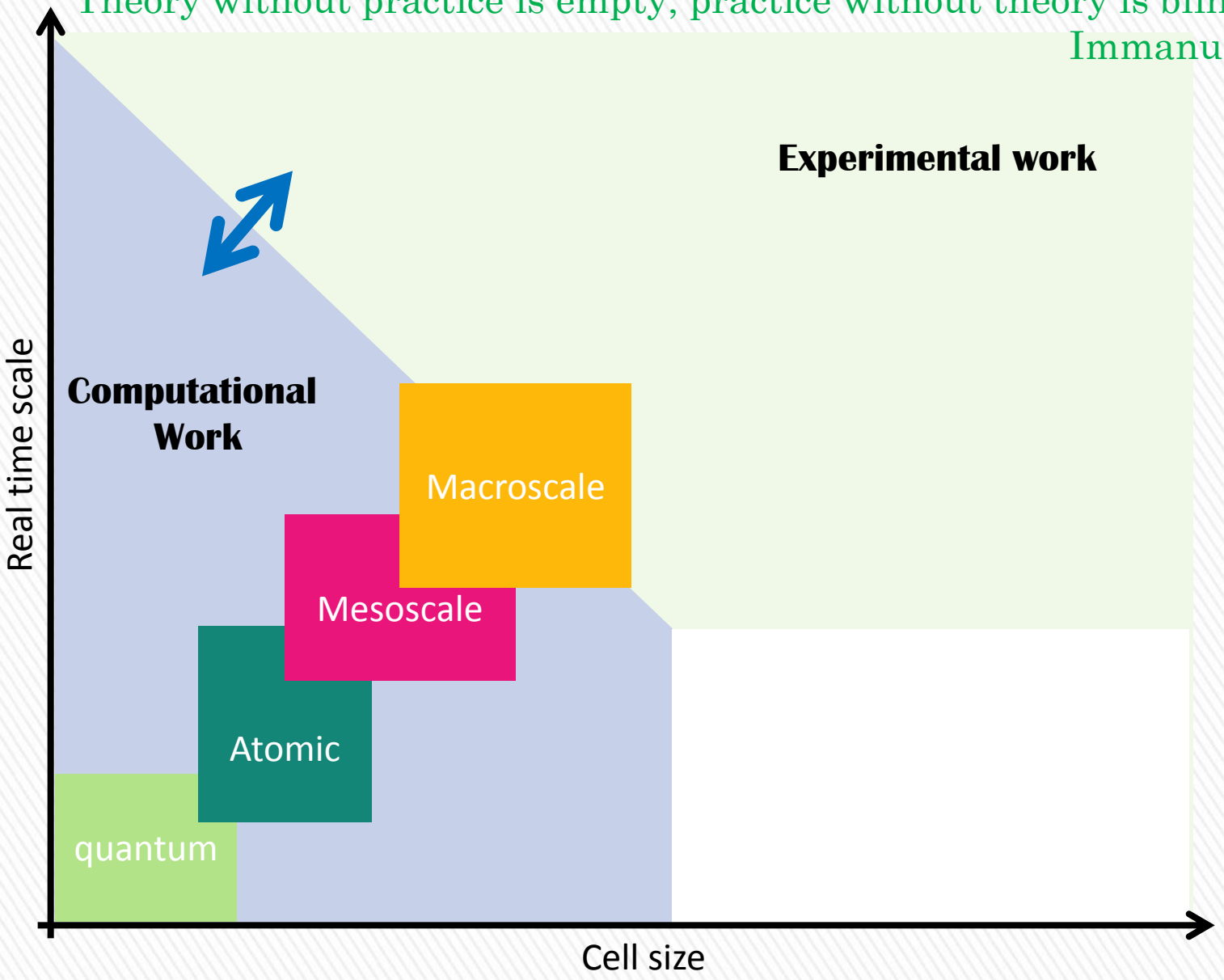
•Science and engineering of interacting surfaces in relative motion.

→Develop High performance experiment to improve the understanding of friction, lubrication and wear.

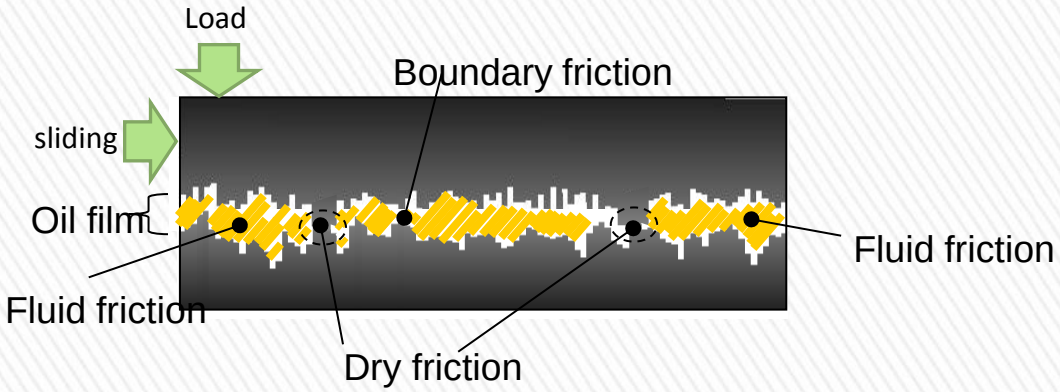


Tribo-simulation

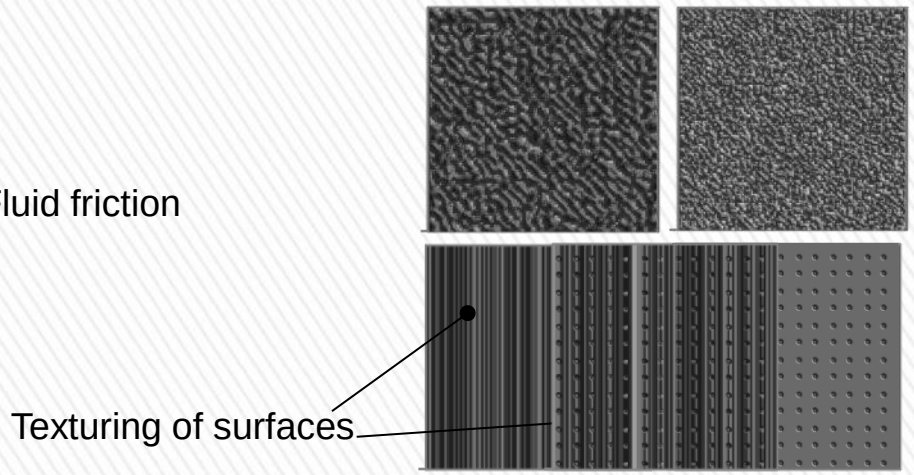
"Theory without practice is empty, practice without theory is blind"
Immanual Kant



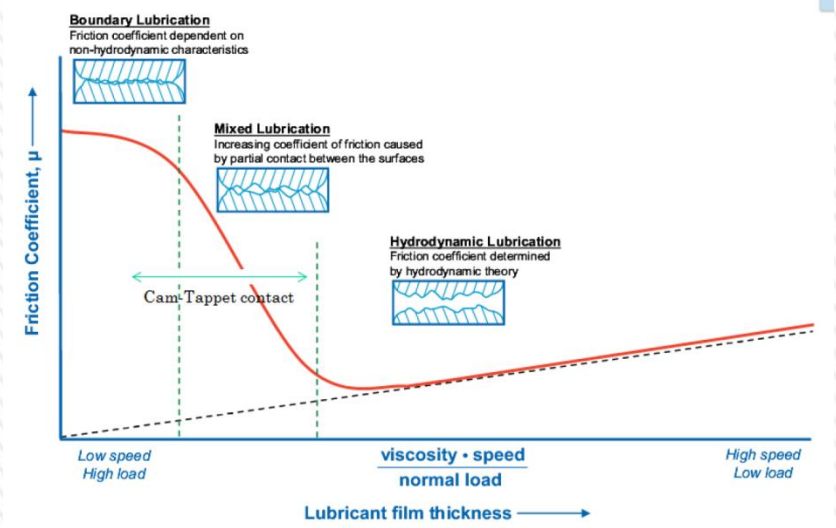
Tribo-simulation at mesoscale

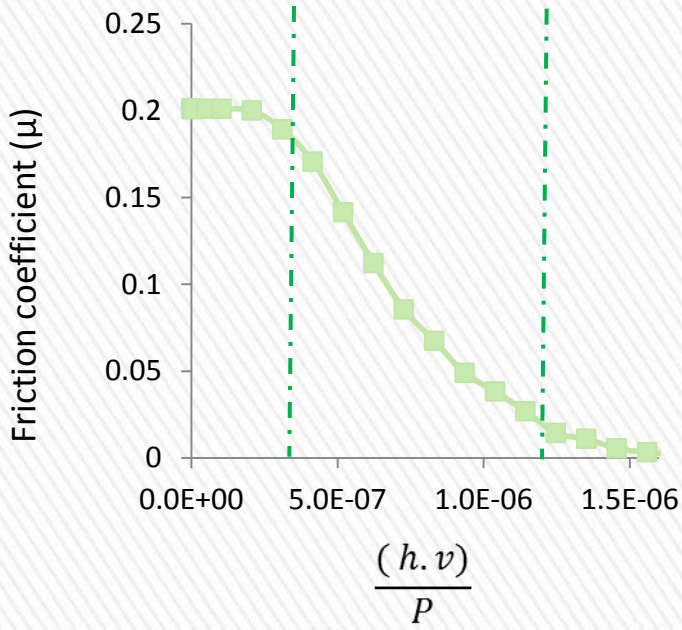


Simulation at mesoscale



Simulation of Stribeck curve using PAO 6 at rt





Acknowledgments

Basic Equation Currently Used in the Simulation

The basic equation of elastic deformation

$$\sigma = E \cdot \varepsilon$$

σ : Stress
E : Elastic coefficient
ε : Strain

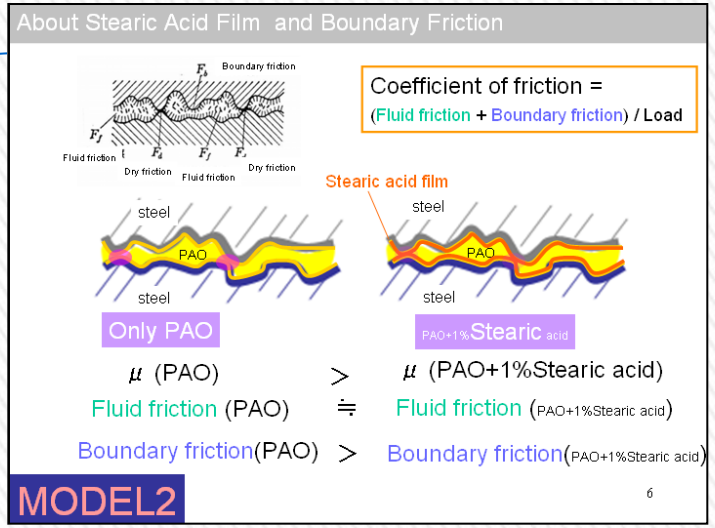
The formula of frictional force

- The basic equation of boundary friction（The boundary film model of Bowden and others）

$$F = A\{\alpha s_m + (1-\alpha)s_t\}$$

The difference in boundary lubrication is expressed.

A : Load burden area
α : The rate which touches directly
s_m : Shearing strength of metal and metal
s_t : Shearing strength of a boundary film



- The basic equation of fluid friction

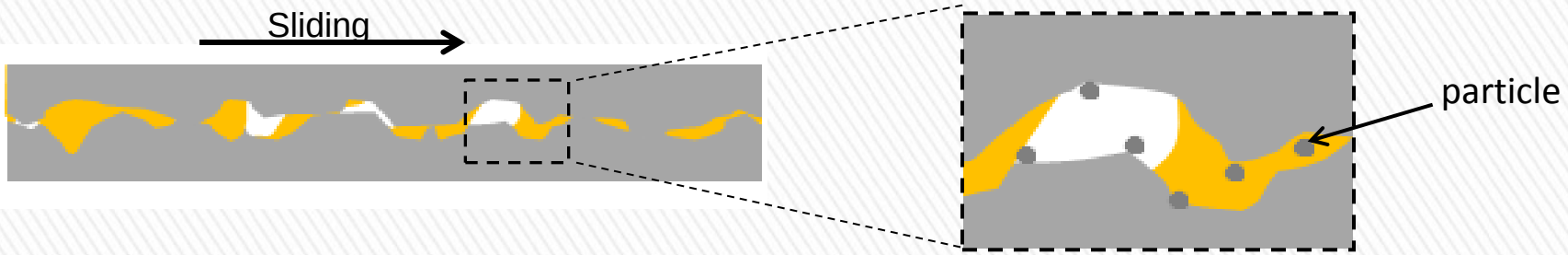
$$F = \eta \cdot U \cdot A / h_0$$

η : Coefficient of viscosity
U : Sliding velocity
h_0 : Average film thickness
A : Area of a friction surface

Basic Equation Currently Used in the Simulation

qualitative monitoring of surfaces

In boundary condition, lubricant generally contains abrasive particles, generated during friction. Their interactions with rubbing surfaces leads to modify the surface to a more fragile state.



At macro-scale , prediction of the amount of wear particle removed in conjunction with friction is an important issue.

The speed of material removal (wear) follows the Preston law which depends on the speed and pressure.

Preston law:

$$w = k_p P v t$$

w: amount of materials removal
k_p: Preston coefficient
P: nominal pressure
v: linear relative speed

$k_p \propto$ friction coefficient (μ)