**Sphere-Plane Resistance Tensor**

The resistance tensor for a sphere moving and rotating near a plane surface relates the translational and rotational velocities to the force and torque on the sphere as

.

To determine the various pieces of the resistance tensor, we can break the problem up into the following sub-problems:

1. Translation normal to the plane surface.
2. Translation parallel to the plane surface.
3. Rotation normal to the plane surface.
4. Rotation parallel to the plane surface.

Let the plane be oriented in the **e**3 direction. The resistance tensors take the following forms

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where the resistance functions , , , , and  depend on the distance *h* between the plane and the sphere center. Below lengths are scaled by the sphere radius *a* and resistance functions by  where *n* = 1, 2, or 3.

**Problem 1.** Translation normal to the plane surface gives the function . This problem has been worked out exactly by Brenner1

,

where . At small surface separations, this exact result can be approximated as

,

where  is the (dimensionless) surface separation.2,3

**Problem 2.** Translation parallel to the plane surface gives the functions  and . This problem has been worked out exactly by O’Neill4 (see MATLAB function *CalcYAYB*). At small surface separations, this exact result can be approximated2,3 as

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**Problem 3.** Rotation parallel to the plane surface gives the functions  and . This problem has been worked out exactly by Dean & O’Neill5 (see MATLAB function *CalcYBYC*). At small surface separations, this exact result can be approximated3 as





**Problem 4.** Rotation normal to a place surface gives the function . This problem has been worked out exactly by Jeffrey6

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At small surface separations, this exact result can be approximated3 as

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**References**

1 H. Brenner, Chem. Eng. Sci. **16**, 242 (1961).

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