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An analytical solution in 2D for the motion of non-rigid elliptical particles with a slipping interface under a general deformation

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By considering the motion of a non-rigid particle immersed in a very viscous flow with a slipping interface (i.e. equality of interface-normal stresses and velocities, and zero shear stress at the interface) an analytical solution for the homogenous internal and heterogeneous external stresses and velocities is derived. Analogue modelling and natural data have pointed to inadequacies in the Jeffery's model (rigid motion with no-slip) for explaining naturally occurring structures and distributions. For example, under simple shear objects should continuously rotate. The slip-model presented here allows for objects to stabilise at an angle to the shear zone boundary and to rotate both synthetically and antithetically into the stable direction. An interesting feature of the solution is that except in the case of absolute rigidity the particle is required to change volume in order to accommodate the deformation.