Forces on a segregating particle[1] RICHARD M. LUEPTOW,
ADITHYA SHANKAR, ALEXANDER M. FRY, JULIO M. OTTINO, PAUL B.
UMBANHOWAR, Northwestern University — Size segregation in flowing granular
materials is not well understood at the particle level. In this study, we perform a se-
ries of 3D Discrete Element Method (DEM) simulations to measure the segregation
force on a single spherical test particle tethered to a spring in the vertical direction
in a shearing bed of particles with gravity acting perpendicular to the shear. The
test particle is the same size or larger than the bed particles. At equilibrium, the
downward spring force and test particle weight are offset by the upward buoyancy-
like force and a size ratio dependent force. We find that the buoyancy-like force
depends on the bed particle density and the Voronoi volume occupied by the test
particle. By changing the density of the test particle with the particle size ratio such
that the buoyancy force matches the test particle weight, we show that the upward
size segregation force is a quadratic function of the particle size ratio. Based on this,
we report an expression for the net force on a single particle as the sum of a size
ratio dependent force, a buoyancy-like force, and the weight of the particle.

Richard Lueptow
Northwestern University

Date submitted: 27 Jul 2017   Electronic form version 1.4