Abstract Submitted
for the DFD16 Meeting of
The American Physical Society

Drag reduction by rotation in granular media. WONJONG JUNG, SUNG MOK CHOI, Seoul National Univertisy, WONJUNG KIM, Sogang University, HO-YOUNG KIM, Seoul National Univertisy — We present quantitative measurements and mathematical analysis of the granular drag reduction by rotation inspired by some self-burrowing seeds whose morphologies respond to environmental changes in humidity. The seeds create a motion to dig into soil using their moisture-responsive awns, which are basically helical shaped in a dry environment but reversibly deform to a linear shape in a humid environment. When the tip of the awn is fixed by an external support, the hygroscopic deformation of the awn gives the seed a thrust with rotation against the soil. By measuring the granular drag of vertically penetrating intruders with rotation, we find the drag to decrease with its rotation speed. Noting that the relative motions of the grains in contact with the intruder induce the collapse of the force chains in the granular bulk, we develop a general correlation for the drag reduction by rotation in terms of the relative slip velocity of the grains, which successfully explains the drag reduction of the rotating intruders including self-burrowing rotary seeds.

Wonjong Jung
Seoul National Univertisy

Date submitted: 31 Jul 2016 Electronic form version 1.4