

Frustrated bearings

Hans J Herrmann (com Rilder S Pires, André A Moreira e José Soares Andrade)

Dept de Fisica, UFC, Fortaleza

In a bearing state touching spheres roll on each other without slip. We frustrate a system of touching spheres by imposing two different bearing states on opposite sides and search for the configurations of lowest energy dissipation. For Coulomb friction (with random friction coefficients) in two dimensions, a sharp line separates the two bearing states and we prove that this line corresponds to the minimum cut. Astonishingly however, in three dimensions, intermediate bearing domains, that are not synchronized with either side, are energetically more favorable than the minimum-cut surface. This novel state of minimum dissipation is characterized by a spanning network of slipless contacts that reaches every sphere. Such a situation becomes possible because in three dimensions bearing states have four degrees of freedom.