MULTI-SCALE MODELING OF SEA ICE MECHANICS AND DRIFT
– **talk** –

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Arctic sea-ice environment is heterogeneous. Indeed, there are areas of high ice concentration, where sea-ice is collected in a large plate, called ice-pack, covering a large surface around the North Pole and there are areas of low ice concentration, called Marginal Ice Zone (MIZ), where sea ice is separated into a plurality of fragment (floes). These floes may interact with each other through inelastic collisions. The pack-ice behavior may be compared to a continuous elactic plate encountering progressive damage and the behavior floes in MIZ may be compared to granular medium. At present, models exists to simulate deformations and cracks in the ice-pack [1] and other to simulate collisions between floes [2]. However no models takes into account the whole spectrum of sea-ice behavior. One of the goals of our research is to build a model linking the different behavior.

First, we interested in behavior floes into MIZ and how deal with collisions between floes. Most models, developed for this kind of problem, considers floes as plate rigid bodies with a shape is circular or the same size. Moreover, this models deal with collisions as response to a inter-penetration. It determine contact forces according to a geometry of the inter-penetration. In order to be more realistic, we build a model where floes can have irregular shape and different size and we determine contact forces according to a kinematic and a geometry of the floes [3]. Thus, we deal with collisions before they lead to a inter-penetration.

This model is implemented using Matlab. In differents configuration, we could check symmetry conservation *Bernoulli's problem*, we could observed kinetic energy dissipation and we could noted a good propagation of impact *Newton's Cradle*.

References

[1] Jérome Weiss, *Drift, Deformation and Fracture of Sea Ice A perspective across scales*, SPRINGER, 2013.

[2] Agnieszka Herman, *Molecular-dynamics simulation of clustering processes in sea-ice floes*, PHYSICAL REVIEW, E 84, 056104, 2011.

[3] Danny Kaufman, *Reflections on Simultaneous Impact*, ACM Transactions on Graphics (SIGGRAPH 2012), 31(4), August 2012.

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