

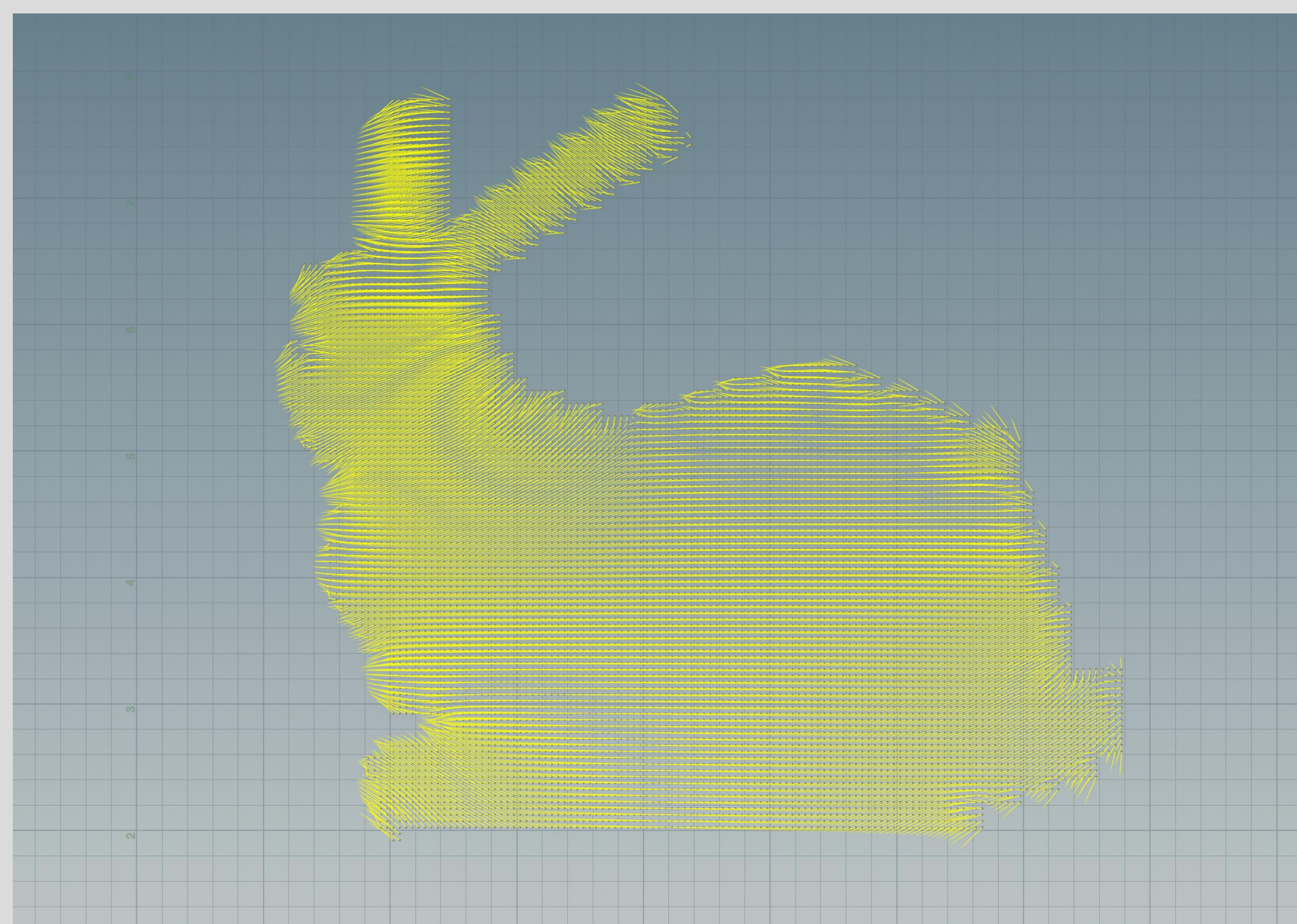
The Simulation of Magnetic Field in Deformable Bodies

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Conclusions

With a method based on SPH (Smoothed-particle hydrodynamics) originally for simulating ferrofluids, we could simulate magnetic field around a magnetic object.

Also, based on this method, we could form construct dynamic simulation between elastic magnetic bodies which could potentially be used in further research on robots with magnetic properties.



Introduction

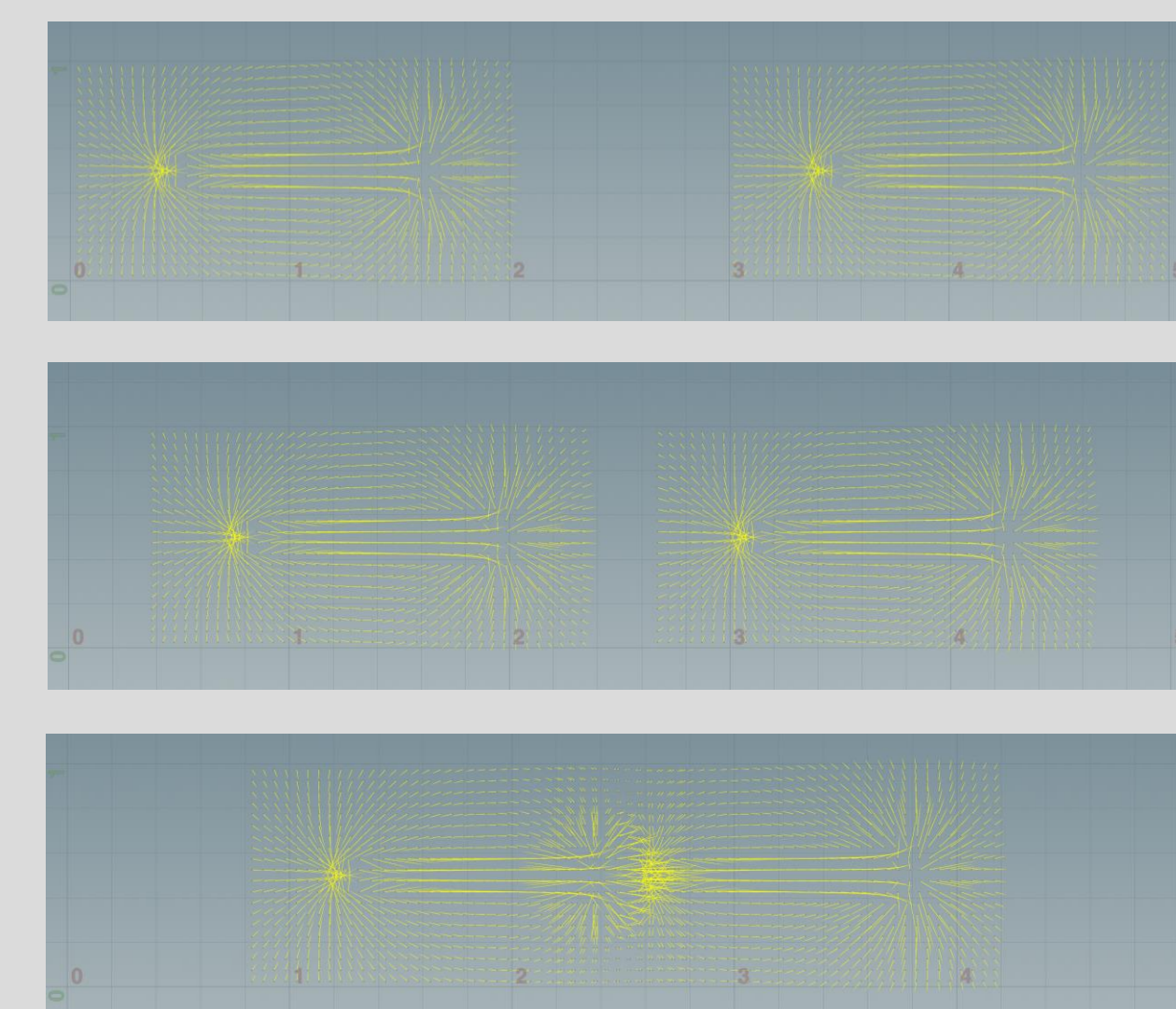
Working upon a simulation code base that utilizes FEM and MPM methods to simulate elastic material under given forces, our goal was to implement in the code base a way to incorporate magnetic forces to be used in simulations.

Methods

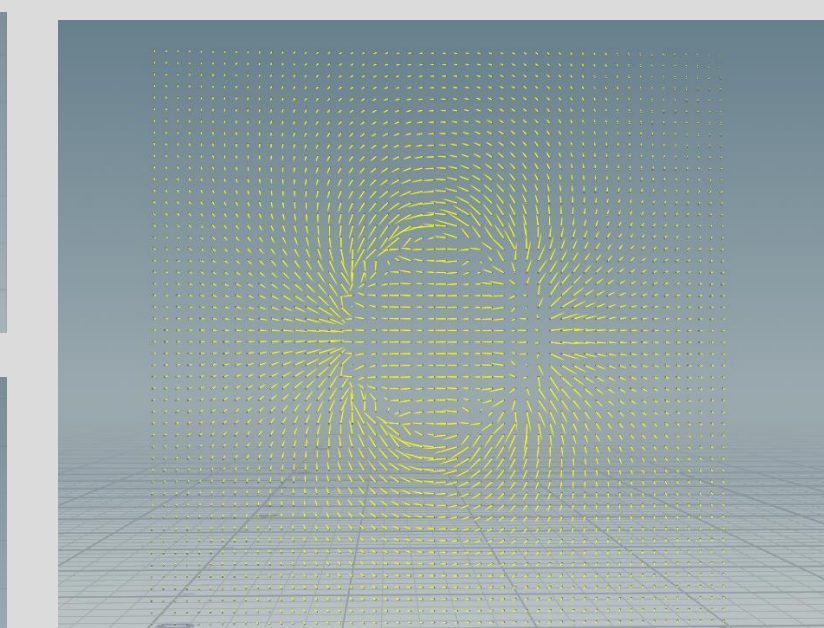
- Examined recent research papers that studies the simulation of magnets (*On the Accurate Large-scale Simulation of Ferrofluids, A Level-Set Method for Magnetic Substance Simulation*)
- Derived formulae for magnetic field generation based on SPH method provided in paper, and plotted diff-test graphs to testify correctness.
- Visualized magnetic field with Houdini and examined its behavior under deformation caused by external forces applied onto the object.

Results & Discussion

Simulation of two bar magnets attracted towards each other.



Visualization of sphere-shaped magnetic field



Although we obtained some visible results of magnets behaving in expected ways, such as forming the correct magnetic field lines and attracting each other when have the same magnetic moment, there is still part of the force calculation that is incorrect and has not been solved at this point. Particularly the force calculation between cells within $2dx$ of each other results in unexpected behaviors. We may further look into that and examine the reason of that. The current visualization results are half-promising that they could be useful in future experiments incorporating magnetic forces into simulations of dynamic bodies.