Comprehensive Modeling of the Effects of Hazardous Asteroid Mitigation Techniques

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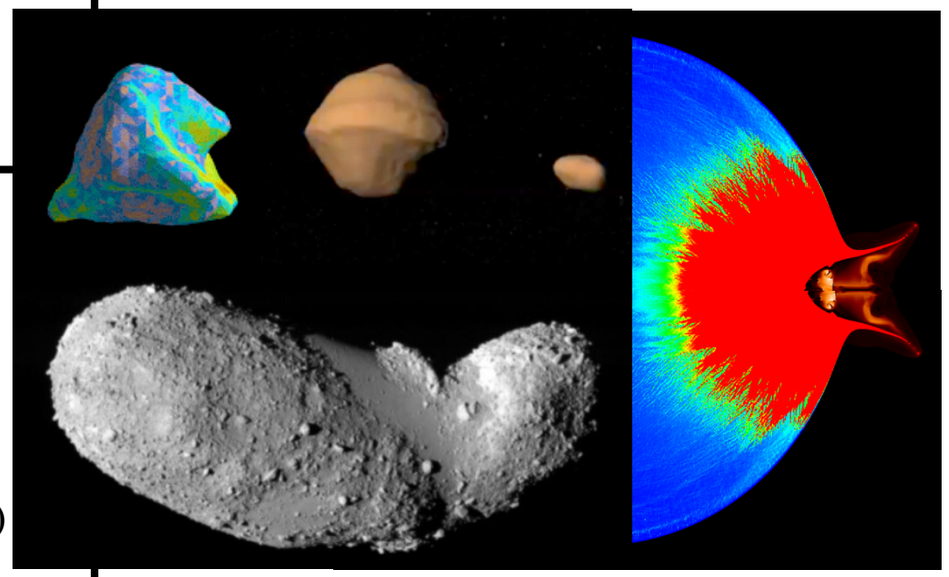
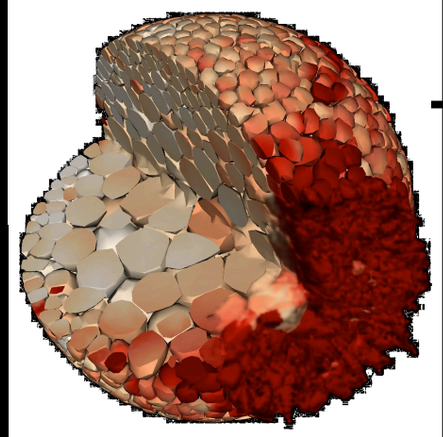
Research Objectives

- Integrate computational tools and theory to create a tool able to evaluate and design hazardous asteroid mitigation techniques.
- Design tools to apply the main mitigation techniques to a realistic range of asteroid morphologies and geophysical parameters: high energy impacts and blasts, non-gravitational energy source, tugs.
- Combine current state of the art scientific computational tools and asteroid analysis and modeling tools into a system software tool that will achieve TRL 4, with elements of TRL 5 with respect to analyzing the system response of a mitigation attempt and scenario using realistic models.





Approach

- Model main mitigation techniques:
  - High energy kinetic impacts and nuclear blasts
  - Non-gravitational techniques using solar photons
  - Asteroid tugs using gravity and ion-beams
- Asteroid shapes/models to motivate development (see figure)
  - Golevka: small, strongly non-spheroidal body
  - Itokawa: rubble pile, strongly bifurcated body, high resolution surface models for statistical analysis
  - 1999 KW4: binary asteroid, fast spinning oblate primary
  - Inputs are rotation state, geophysical and material parameters
- Scientific state of the art computational simulations (see figure)
  - Leverage Lawrence Livermore National Lab tools
  - Particle SPH+Nbody and Lagrangian Codes
- Develop statistical maps between mitigation techniques and input models to outcomes, enabling evaluation and design

Potential Impact

- Creates a state of the art computational tool for predicting, evaluating and designing asteroid mitigation scenarios
- Enables strategic development of mitigation responses to future actual and hypothesized hazardous asteroid mitigation scenarios
- Allows for a metric-based approach for choosing which mitigation technologies to further pursue and develop