Mission Objective

- Demonstrate the feasibility of electromagnetic control for formation-flying satellites.
- 2-D Flat floor test bed → Simplifies problem while achieving objective
- 3 independent devices → Proves feasibility of planar control
- 3 DOF per device → Simplifies dynamics

Planar control vs. linear control… it takes 3 points to make a plane. Plus, if we can prove controllability for 3 devices, adding more should be… trivial…
Separation distance: $O(10\text{cm})$-$O(1\text{m})$
Design Trades

- Mass
- Cost ($)
- Time
- Control accuracy
- Control precision

- Electrical power (current, voltage, resistivity)
- Feasibility
- B-field
## Design Concept: Part I

<table>
<thead>
<tr>
<th>Item</th>
<th>Pros</th>
<th>Cons</th>
</tr>
</thead>
<tbody>
<tr>
<td>External power source</td>
<td>- Simplifies problem while achieving objective</td>
<td>- Not configuration used in space</td>
</tr>
<tr>
<td>Air bearing</td>
<td>- Provides near-frictionless test environment</td>
<td>- Effective representation of dynamics</td>
</tr>
<tr>
<td></td>
<td>- Cost</td>
<td>- Requires air supply</td>
</tr>
<tr>
<td>Bumpers</td>
<td>- Safety consideration</td>
<td>- Low cost</td>
</tr>
</tbody>
</table>

Power: Also, can take more data at various power levels.
Design Concept: Part II

- One electromagnet, reaction wheel assembly per device
  - Permits full range of motion
  - Simplified dynamics
  - Less mass
  - Need more for control of more DOF

- All circuitry oriented to move with EM package (aligned with field)
  - Reduces magnetic interference with circuits
  - Reduces need for shielding

- Shielding using high-permeability materials
  - Prevents magnetic interference
  - Mass vs. cost tradeoff
Design Concept: Inter-device Positioning

Relative Metrology

Infrared Sensors
- Highly directional
- Computer capacity

Sonar
- Directional
- Not functional in space

pseudo-GPS
- Omnidirectional
- Computer capacity
Operations Concept

- Human interface via laptop computer
  - Familiar to users
  - Portable
  - Supports adequate software packages
  - Not used in actual space mission
  - Applicable to actual operational situation
  - Fast
  - Simulates actual operational situation
  - More complicated avionics

- Ground/device communication via RF wireless modem
Questions?