



Astrobees Mapping and Localization



Andres Mora

Astrobees Facilities Team

JAXA Kibo Robotic Programming Challenge Student Seminar

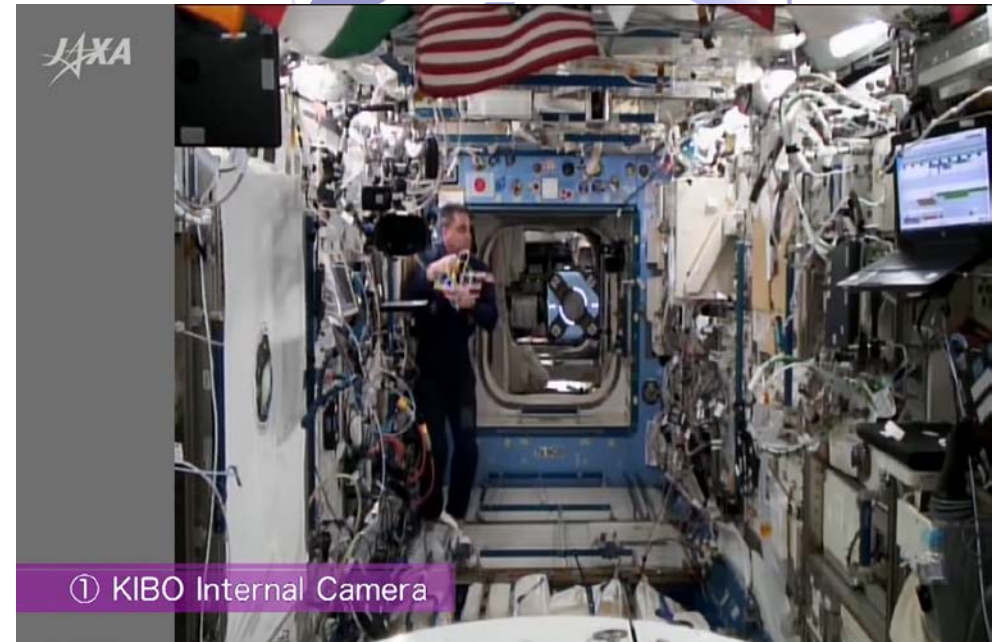
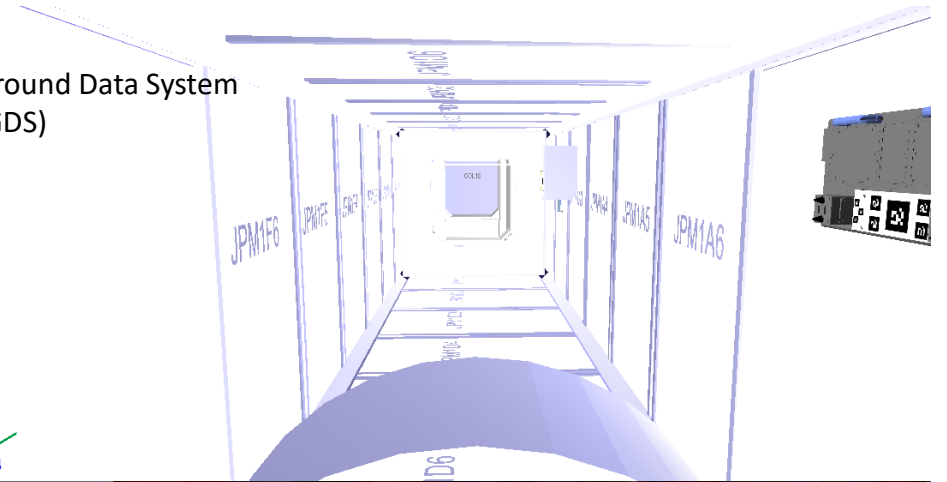
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Japanese Experimental Module (JEM)

- "Kibo" is Japan's 1st manned experiment facility. Largest experiment module on the International Space Station (ISS).
- It consists of two experiment facilities, the Pressurized Module (PM) and the Exposed Facility (EF).
- PM is 11.2 meters long and 4.4 meters in diameter, atmospheric pressure is maintained to 1 atm.
- Scientific experiments using the microgravity environment and cosmic radiation are being carried out on the experiment racks in the PM.
- Kibo may temporarily be used for Cargo Transfer Bags (CTBs) storage purposes.
- 3D simulated environment helps plan ideal Astrobees trajectories and missions.

Ground Data System (GDS)

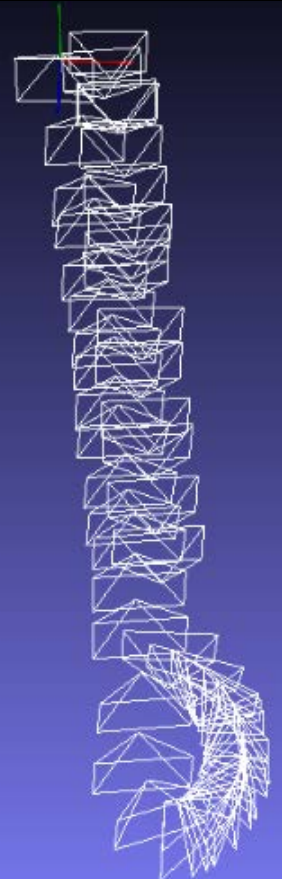


① KIBO Internal Camera



Astrobee Mapping

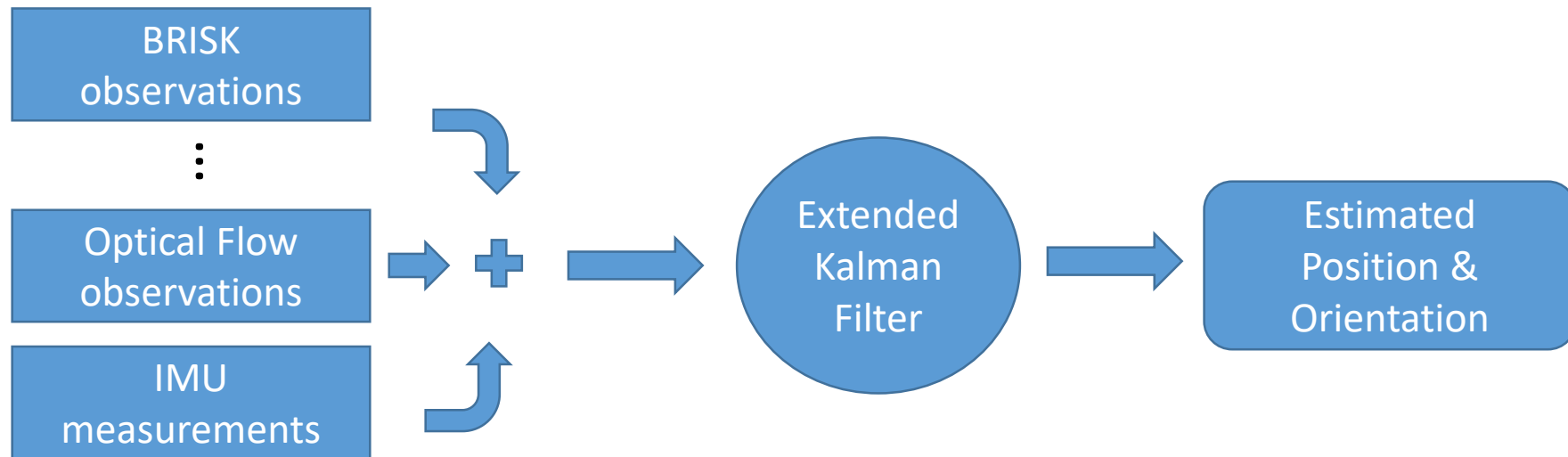
- Process
 - Map is built offline, separate from localization.
 - Astronaut moves Astrobee inside JEM to collect initial set of images.
 - Visual features are detected and matched across a collection of these images.
 - Features' 3D positions are jointly optimized using structure from motion (SfM) similar to [1].
 - Later on, new images can be acquired autonomously by Astrobee.
- Environmental changes adversely affect mapping and localization: lighting, objects.





Astrobee Localization

- The localization algorithm matches specific “sparse” BRISK features between NavCam images and the map.
- The localization algorithm also utilizes IMU information and “inertial flow” features.





Astrobee Mapping & Localization

- Challenges

- Kibo's lights replaced by new SSLA lights (bays 1, 4, &6).
- Tracking of SSLA light settings.
- Account for differences between simulated and real-world in mission planning.
- Account for unforeseen changes in environment not captured in map.
- Account for areas where the environment has surfaces with no detectable features