Dynamically Scheduling Direct Imaging Missions

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Direct imaging missions being planned, like HabEx and LUVOIR, use a partially dynamic mission schedule. In the first half of the mission they make a series of predetermined observations and revisit promising targets in the second half. However, this kind of mission schedule risks missing the optimal times to revisit promising target stars when during the first half of the mission. Here, we show a method for a fully dynamic mission schedule. To do this we generate a cloud of potential planets around the list of target stars and identify which planets in the cloud would be detectable to the telescope. We use that to calculate the probability of detecting a planet around the star. After an observation we update which potential planets can be eliminated from the search.

Results for 1000 Mission Simulations with WFIRST Instruments and 7 Months of Observation Time

- **Static mission schedule**
  - Probability of detection:
    - Static mission (μ = 9.87)
    - Partially dynamic mission (μ = 10.24)
    - Dynamic mission (μ = 13.22)

- **Partially dynamic mission schedule**
  - Probability of detection:
    - Static mission (μ = 9.87)
    - Partially dynamic mission (μ = 13.39)
    - Dynamic mission (μ = 27.92)

- **Dynamic mission schedule**
  - Probability of detection:

**Schedule Planning**

- **Static**
  - Before mission
    - Create list of target stars
  - After mission
    - Confirm discovery
  - Conclude planning

- **Dynamic**
  - Before mission
    - Create list of potential planets
  - After mission
    - Update potential planets
  - Conclude planning

**Probability of Detection**

- The probability of detection is the number of detectable potential planets divided by the number of potential planets remaining in the simulation.
- The potential planets generated are dependent on the assumed planetary occurrence rate. The results above assume the SAG13 occurrence rate to give a general exoplanet distribution.
- The probability of detection is an extension of completeness [2][3].

**Conclusions**

- A dynamic schedule outperforms static and partially dynamic schedules for both total exoplanets and unique exoplanets.
- Partially dynamic schedules outperform static schedules.

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**Acknowledgments**

This work is supported by NASA Grant Nos. NNX15AB40G - SCIENCE REQUIREMENTS, MISSION OUTLINE, AND SCIENCE YIELD FOR THE AFTA CORONAGRAPH

**References**

