Jet Propulsion Laboratory
California Institute of Technology

Fast Linearized Coronagraph Optimizer (FALCO):

An Overview

Last updated on 2018-04-11
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Outline

1) Main Goals and Key Features

2) Block Diagram of Code Structure

3) Diagrams of Optical Layouts for Different Coronagraph Types

FALCO: Main Goals and Key Features

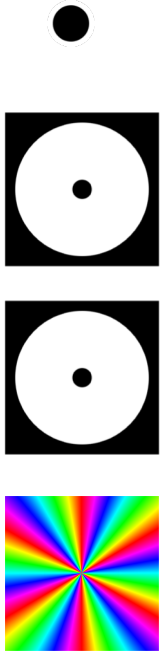
Goals

1. Provide example code for WFSC with several types of coronagraphs
   a) Usable for simulations, testbed experiments, and/or optimization of DM shapes for design.
   b) Uses PROPER library. Acts as WFSC wrapper around PROPER.
2. Provide a platform for different groups to add their own algorithms

Key Features:

- Provide rapid DM response matrix (aka control Jacobian) calculations for different classes of coronagraphs.
  - Algorithms used are orders of magnitude faster than conventional, direct methods.
  - May enable on-orbit calculations of control Jacobians for future missions.
- Testbed-specific code is modular and portable to different high-contrast coronagraph testbeds.
- Languages:
  - **Matlab** currently
  - **Python**
    - Translation not yet started. PyFALCO will be object-oriented.

FALCO: Classes of Coronagraphs
(Based on Jacobian Propagation Method to/from FPM)



- Babinet's Principle:
  - Occulting spot (LC, DMLC, APLC, HLC, APHLC)
- Single MFT
  - Opaque occulting spot + opaque outer diaphragm (FLC, SPLC)
- Double MFT
  - High-res occulting spot + opaque outer diaphragm *[coming soon]*
- FFT
  - Infinite/pseudo-infinite FPM (vortex)

- Classical PIAA not included because it cannot be used with Fresnel propagation

FALCO Code Structure

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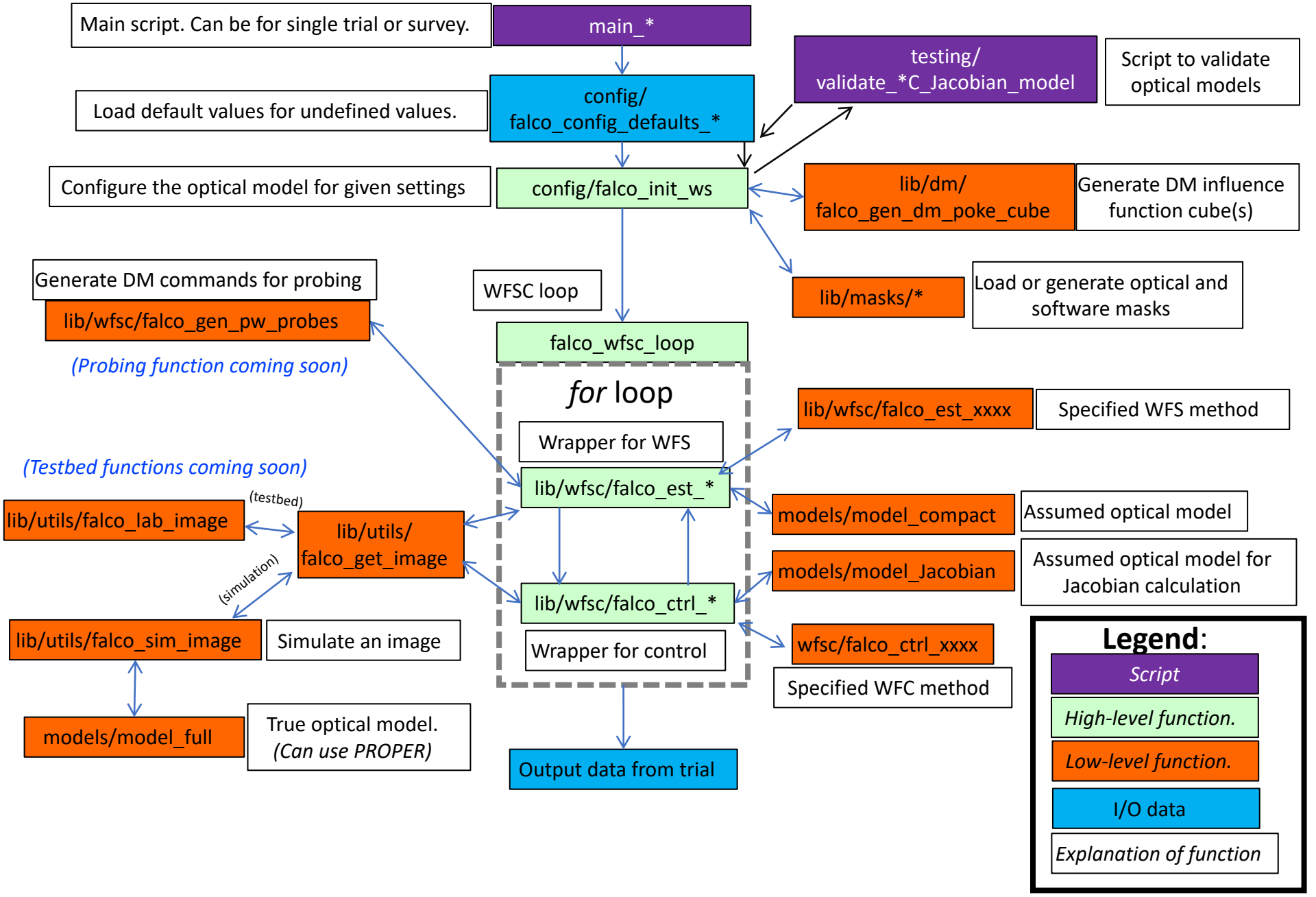
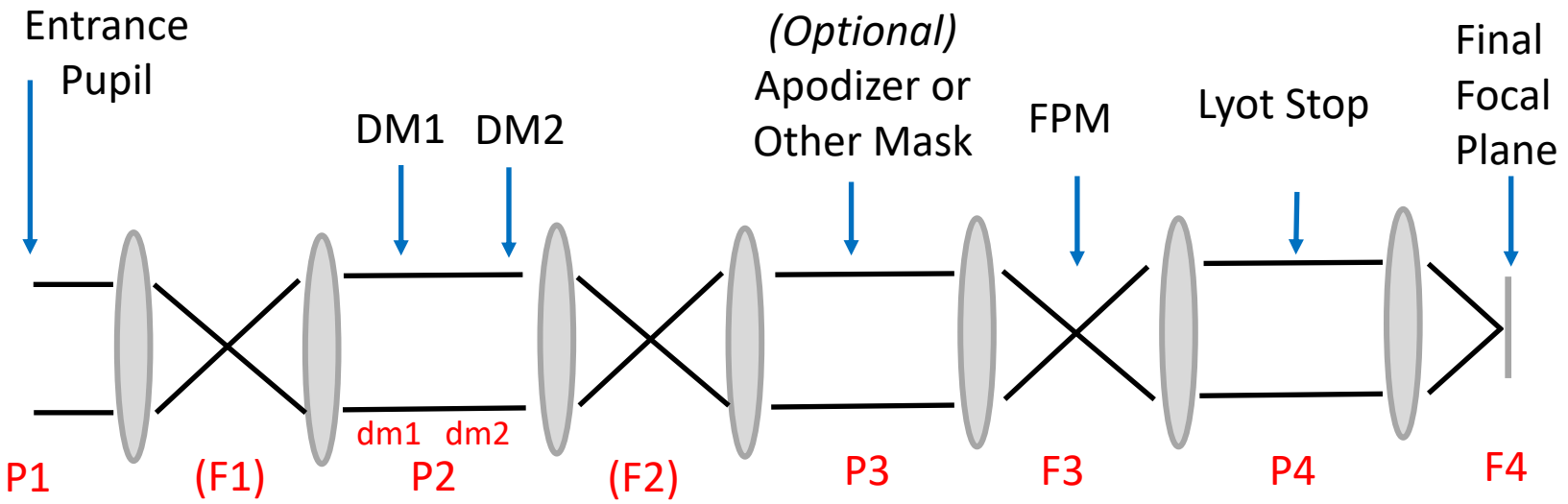


Mutual Layout for All Coronagraph Types



Shorthand names of planes are in red

- Assume that the input pupil, apodizer, and Lyot stop are all at conjugate pupil planes
- DM1 and DM2 can be anywhere in the collimated beam near pupil plane P2.
- Focal planes F1 and F2 are empty. The final focal plane F4 can have a field stop superimposed on the detector.
- The rapid propagation method to/from the FPM varies with coronagraph type based on:
  - Outer FPM cutoff radius (finite or pseudo-infinite)
  - Finite inner mask (e.g., a spot) or pseudo-infinite (e.g., a vortex)