Marcos van Dam
Flat Wavefronts

Jesse Cranney
Australia National University

Antonin Bouchez
Giant Magellan Telescope Observatory

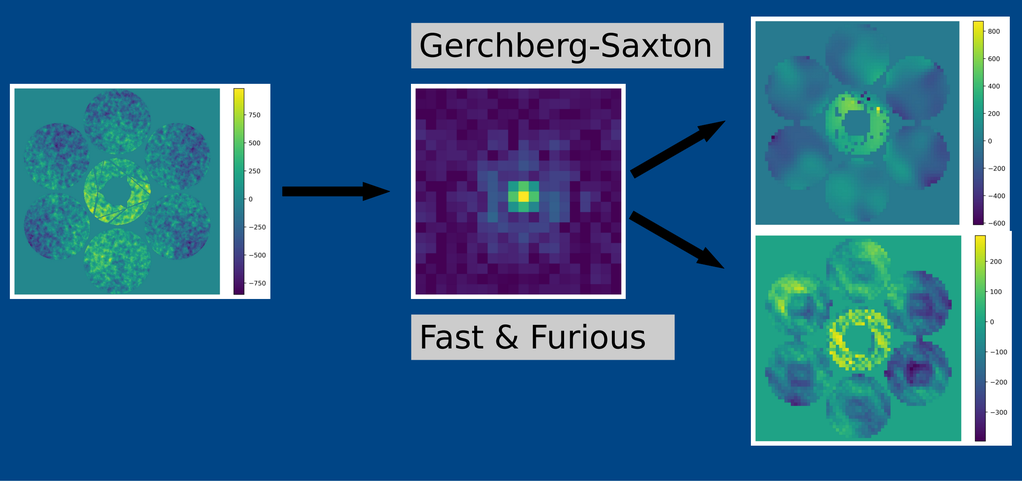
Segment piston estimation using sequential phase retrieval

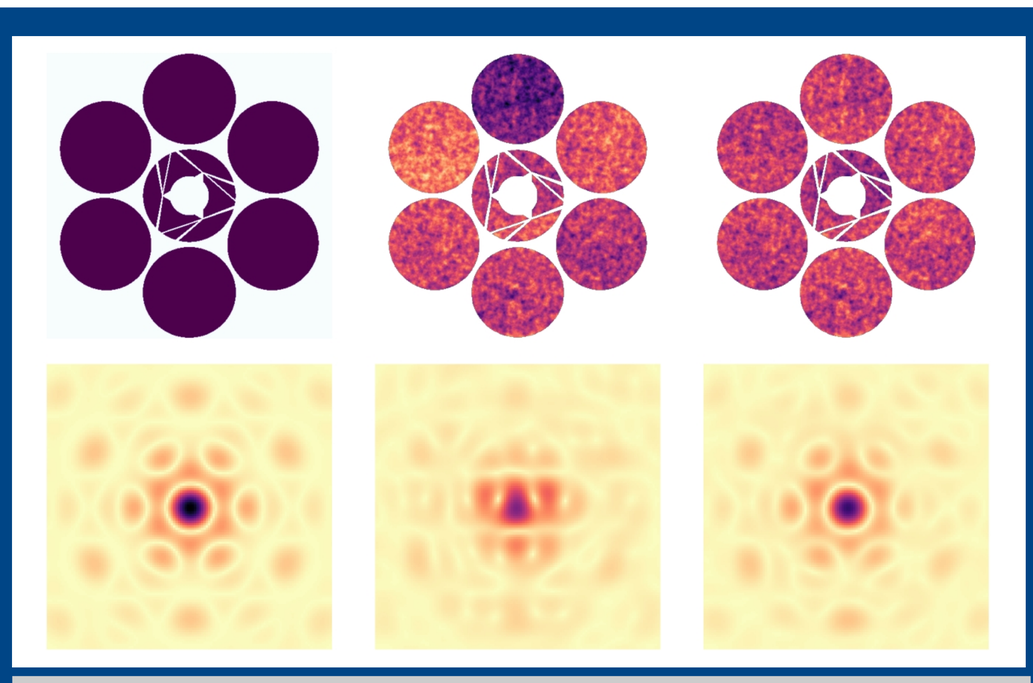
Overview

The GMT Laser Tomography AO system is blind to segment piston

We measure segment piston from K-band tip-tilt sensing images using phase retrieval.

Sequential Gerchberg-Saxton and Fast & Furious are compared



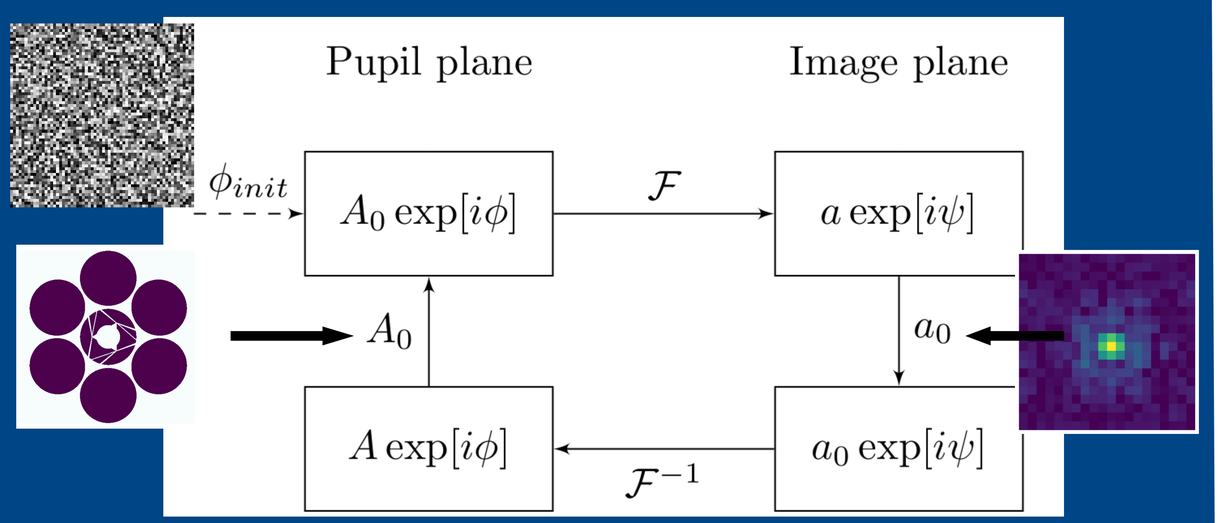


Sequential Gerchberg-Saxton

Non-linear iterative algorithm with the pupil and image amplitude acting as constraints

For a symmetric pupil, φ(x,y) and -φ(-x,-y) produce the same image (known as “phase ambiguity”)

Phase ambiguity problem is resolved by comparing last applied piston commands with the measured change in piston.

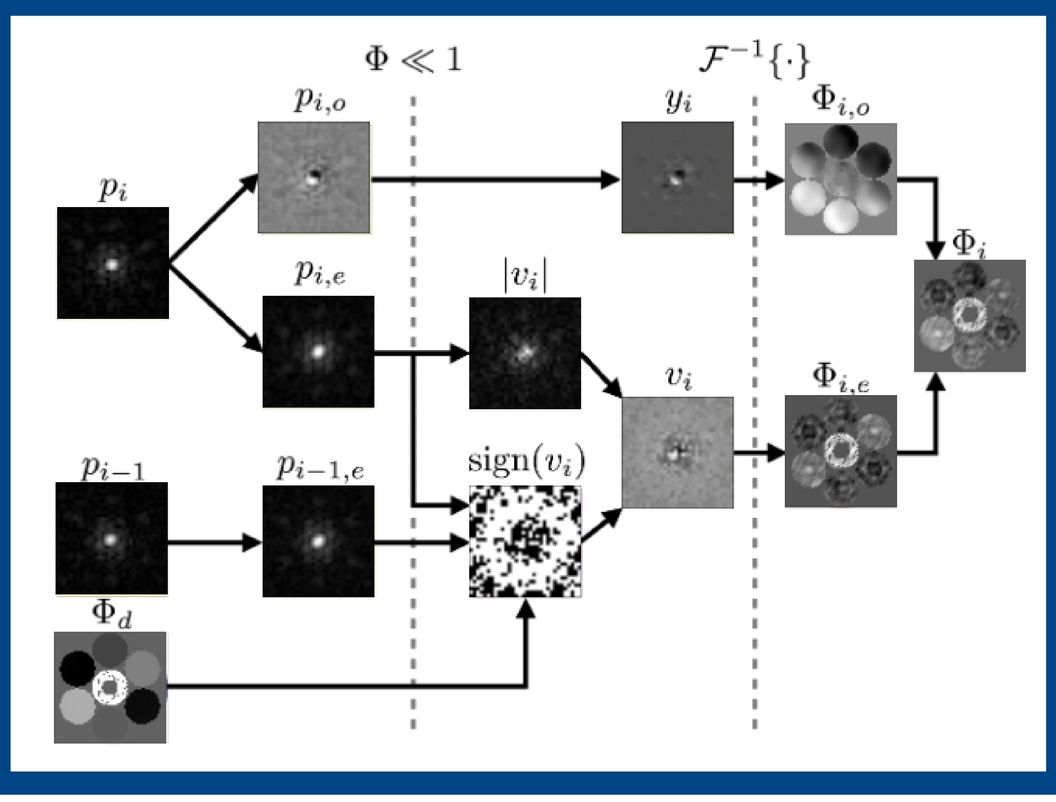


Fast & Furious

Small phase approximation to phase retrieval problem

Deterministic non-linear solution

Phase ambiguity problem is resolved using previous image and change in applied piston.



Simulations

End-to-end LTAO simulations were run in CEO, a GMT simulation environment written in Python with GPU acceleration.

Tip-tilt and segment piston estimates made at 500 Hz

Simulations with ideal and no segment piston measurement, as well as Fast & Furious and Sequential Gerchberg-Saxton

The seeing, off-axis distance and magnitude were varied.

Both Sequential Gerchberg-Saxton and Fast & Furious perform well and are fast enough.

Sequential Gerchberg-Saxton deals better with high residual wavefronts

Fast & Furious deals better with faint guide stars