Information Technology and Software

Shaped External Occulter Software Suite

Optically models diffraction from occulter for improved exoplanet coronagraphy

NASA Goddard Space Flight Center has developed a suite of software, written entirely in C, for optically modeling diffraction from an arbitrarily shaped external occulter for exoplanet coronagraphy and for propagating the fields through an arbitrary telescope. The software allows an external occulter to be used in imaging systems (such as telescopes) that relaxes the tolerances needed on the imaging system and increases the light contrast by ten orders of magnitude. It works both broadband and narrowband and runs on a single processor computer in ~2 minutes per wavelength.

BENEFITS

- Allows for use of an external occulter which suppresses light before entering the telescope thereby levying no stringent optical requirements on the telescope.

- Enables smaller aperture telescopes to achieve the same coronagraphic resolution and similar sensitivity as larger ones.

- Allows modeling to be performed on smaller computers (and even laptops).

- Allows the use of an external occulter system which works with filled, segmented or even sparse aperture systems.

technology solution

THE TECHNOLOGY

Assessment of the optical performance of a given occulter design requires Fresnel diffraction in 2-dimensions to propagate the light from the external occulter to the telescope and then further diffractive propagation through the telescope to the focal plane. This software performs these two propagations, with the addition of manufacturing, deployment, vibrational errors, holes and deformations on the external occulter, and with the addition of wavefront and amplitude errors within the telescope. The propagation approach is parametric with respect to the wavelength of light and with respect to mispointing of the occulter and telescope relative to the star. The software propagates the ideal occulter separately from calculating errors, eliminating the need for large computers to perform these calculations.

APPLICATIONS

The technology has several potential applications:

- ⟳ Amateur Solar Telescopes
- ⟳ Professional Solar Telescopes
- ⟳ Medical Imaging
- ⟳ Microscopy
- ⟳ Beam forming optics for Defense

PUBLICATIONS

Patent No: 9396294