Technology Focus: Data Acquisition

Software Tool Integrating Data Flow Diagrams and Petri Nets

Lyndon B. Johnson Space Center, Houston, Texas

Data Flow Diagram – Petri Net (DFPN) is a software tool for analyzing other software to be developed. The full name of this program reflects its design, which combines the benefit of data-flow diagrams (which are typically favored by software analysts) with the power and precision of Petri-net models, without requiring specialized Petri-net training. (A Petri net is a particular type of directed graph, a description of which would exceed the scope of this article.)

DFPN assists a software analyst in drawing and specifying a data-flow diagram, then translates the diagram into a Petri net, then enables graphical tracing of execution paths through the Petri net for verification, by the end user, of the properties of the software to be developed. In comparison with prior means of verifying the properties of software to be developed, DFPN makes verification by the end user more nearly certain, thereby making it easier to identify and correct misconceptions earlier in the development process, when correction is less expensive. After the verification by the end user, DFPN generates a printable system specification in the form of descriptions of processes and data.

This work was done by Carroll Thronesbery of S&K Technologies and Madjid Tavana of LaSalle University for Johnson Space Center. Further information is contained in a TSP (see page 1). MSC-23242

Adaptive Nulling for Interferometric Detection of Planets
Deep nulls would be obtained despite optical imperfections.

NASA's Jet Propulsion Laboratory, Pasadena, California

An adaptive-nulling method has been proposed to augment the nulling-optical-interferometry method of detection of Earth-like planets around distant stars. The method is intended to reduce the cost of building and aligning the highly precise optical components and assemblies needed for nulling.

Typically, at the mid-infrared wavelengths used for detecting planets orbiting distant stars, a star is millions of times brighter than an Earth-sized planet. In order to directly detect the light from the planet, it is necessary to remove most of the light coming from the star. Nulling interferometry is one way to suppress the light from the star without appreciably suppressing the light from the planet.

In nulling interferometry in its simplest form, one uses two nominally identical telescopes aimed in the same direction and separated laterally by a suitable distance. The light collected by the two telescopes is processed through optical trains and combined on a detector. The optical trains are designed such that the electric fields produced by an on-axis source (the star) are in anti-phase at the detector while the electric fields from the planet, which is slightly off-axis, combine in phase, so that the contrast ratio between the star and the planet is greatly decreased. If the electric fields from the star are exactly equal in amplitude and opposite in phase, then the star is effectively "nulled out."

Nulling is effective only if it is complete in the sense that it occurs simultaneously in both polarization states and at all wavelengths of interest. The need to ensure complete nulling translates to extremely tight demands upon the design and fabrication of the complex optical trains: The two telescopes must be highly symmetric, the reflectivities of the many mirrors in the telescopes and other optics must be carefully tailored, the optical coatings must be extremely uniform, sources of contamination must be minimized, optical surfaces must be nearly ideal, and alignments must be extremely precise. Satisfaction of all of these requirements entails substantial cost.
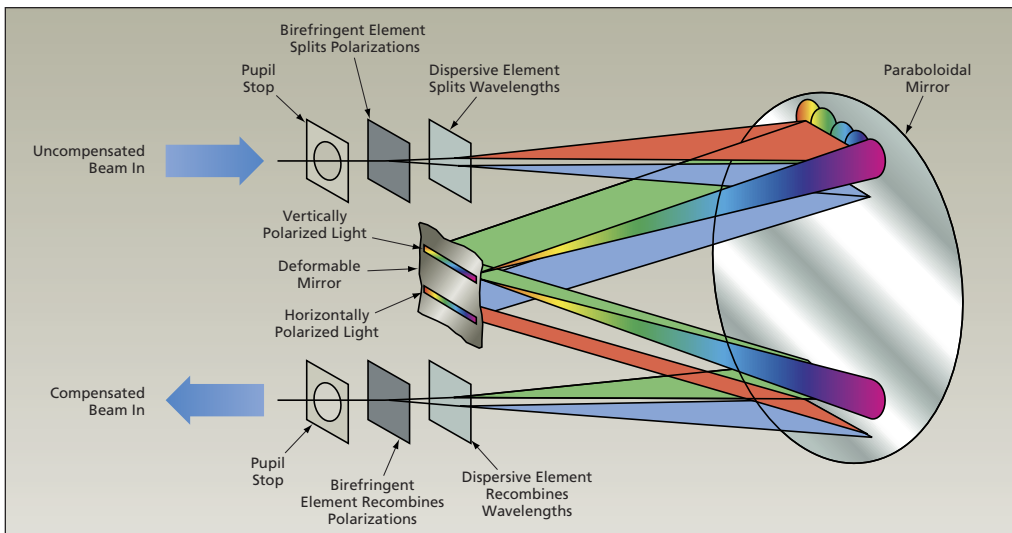
Light Would Be Decomposed into wavelength and polarization components, the phases and amplitudes of which would be controlled by use of a deformable mirror. The components would then be recombined to obtain a compensated beam.