Books & Reports

Efficient Coupler for a Bessel Beam Dispersive Element

A document discusses overcoming efficient optical coupling to high orbital momentum modes by slightly bending the taper dispersive element. This little shape distortion is not enough to scramble the modes, but it allows the use of regular, free-beam prism coupling, fiber coupling, or planar fiber on-chip coupling with, ultimately, 100 percent efficiency.

The Bessel-beam waveguide is bent near the contact with the coupler, or a curved coupler is used. In this case, every Bessel-beam mode can be successfully coupled to a collimated Gaussian beam. Recently developed Bessel-beam waveguides allow long optical delay and very high dispersion. Delay values may vary from nanoseconds to microseconds, and dispersion promises to be at 100 µs/nm. Optical setup consisted of a red laser, an anamorphic prism pair, two prism couplers, and a bent, single-mode fiber attached to prisms. The coupling rate increased substantially and corresponded to the value determined by the anamorphic prism pair.

This work was done by Anatoliy Savchenkov, Vladimir Iltchenko, Andrey Matsko, Thanh Le, Nan Yu, and Lute Maleki of Caltech for NASA's Jet Propulsion Laboratory. Further information is contained in a TSP (see page 1). NPO-45440

Attitude and Translation Control of a Solar Sail Vehicle

A report discusses the ability to control the attitude and translation degrees-of-freedom of a solar sail vehicle by changing its center of gravity. A movement of the spacecraft's center of mass causes solar-pressure force to apply a torque to the vehicle. At the compact core of the solar-sail vehicle lies the spacecraft bus which is a large fraction of the total vehicle mass. In this concept, the bus is attached to the spacecraft by two single degree-of-freedom linear tracks. This allows relative movement of the bus in the sail plane. At the null position, the resulting solar pressure applies no torque to the vehicle. But any deviation of the bus from the null creates an offset between the spacecraft center of mass and center of solar radiation pressure, resulting in a solar-pressure torque on the vehicle which changes the vehicle attitude. Two of the three vehicle degrees of freedom can be actively controlled in this manner. The third, the roll about the sunline, requires a low-authority vane/propulsive subsystem.

Translation control of the vehicle is achieved by directing the solar-pressure-induced force in the proper inertial direction. This requires attitude control. Attitude and translation degrees-of-freedom are therefore coupled. A guidance law is proposed, which allows the vehicle to stationkeep at an appropriate point on the inertially-rotating Sun-Earth line. Power requirements for moving the bus are minimal. Extensive software simulations have been performed to demonstrate the feasibility of this concept.

This work was done by Gurkirpal Singh of Caltech for NASA's Jet Propulsion Laboratory. Further information is contained in a TSP (see page 1). NPO-44129