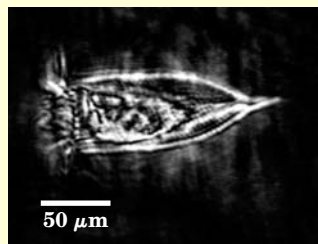


Fiber optics pinpoints structural problems.

At a recent optical-fiber meeting in California, physicists from Canada's University of Ottawa reported on a distributed Brillouin sensor that can detect deformation, cracks, and bending under real-world conditions. The DBS system uses optical fibers in contact with the structure under study. A pulse of laser light and a continuous optical beam of a different frequency are sent in opposite directions through the fibers. When the underlying structure is stressed, the resulting phonons slightly change the refractive index in the adjacent part of the fiber through a phenomenon called the Brillouin effect. Careful monitoring of the frequency difference between the counterpropagating light waves provides precise information on the mechanical strains. The system's 15-cm spatial resolution is determined by the laser's 1.5-ns pulse width. In one demonstration, the Ottawa researchers glued optical fiber along the length of a section of pressurized natural-gas pipeline subjected to bending and buckling. In another demonstration, the researchers tested the DBS system on a reinforced concrete column subjected to simulated seismic forces. In both cases, problems were detected and located well before the structure failed; such early localization is difficult with current structural-health analysis, which is done on a spot-by-spot basis. (See paper OTuL7 at the meeting website, <http://www.ofcnfoec.org>, and F. Ravet et al., *IEEE Photonics Tech. Lett.* **18**, 394, 2006.) —BPS

Submersible holographic microscope. A low-cost, 20-kg device has been developed that allows scientists to form three-dimensional images of the trajectories of tiny marine organisms in their natural environment. Scientists at Dalhousie University in Halifax, Canada, used a simple hologram arrangement: Laser light is focused onto a pinhole aperture in the laser's watertight housing. The spherical waves that emanate from that point source then illuminate a sample of seawater, scatter from objects in the water, and recombine—at the photosensitive area of a CCD camera housed in a separate container—with the reference beam that went straight through the seawater without scattering. The digital holograms are then reconstructed into images of the objects. Shown here is a marine ciliate *Favella*, imaged with a 0.2-ms exposure at a depth of 10 m as the animal swam from right to left at 2.1 mm/s.

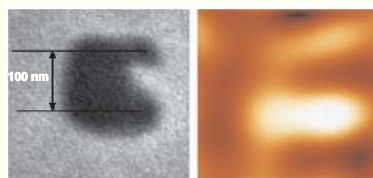


Holograms with 1024×1024 pixels can be recorded at up to 10 frames per second, a rate at which the swimming and feeding characteristics of the organisms can be studied. Past generations of

submersible holographic microscopes weighed several tons, had to be deployed from large ships, and used film as the recording medium. (S. K. Jericho et al., *Rev. Sci. Instrum.* **77**, 043706, 2006.) —PFS

Plasmon microscope with super-resolution.

Plasmons are essentially electromagnetic modes that can arise and propagate on a metal surface. Much as a photon is a localized manifestation of a free-space EM field, a surface plasmon polariton (SPP) is a localized excitation in a plasmon field. Last year, Igor Smolyaninov of the University of Maryland and his colleagues demonstrated a far-field light microscope, based on SPPs traveling on



a glycerine-wetted gold film, that could achieve a resolution better than 100 nm. As reported at the March 2006

meeting of the American Physical Society, the researchers have improved the device's resolution to about 60 nm by nanopatterning the gold film, much like a photonic crystal. They then used digital image-processing techniques to approach 30-nm resolution. The SPPs were excited with light of about 515 nm. Shown here is a C-shaped hole imaged on the left with a scanning electron microscope and on the right with an SPP-assisted standard light microscope. (I. I. Smolyaninov et al., *Phys. Rev. Lett.* **94**, 057401, 2005; I. I. Smolyaninov et al., *Phys. Rev. B* **72**, 085442, 2005; I. I. Smolyaninov et al., *Appl. Phys. B*, in press.) —PFS

Clean signals and calm seas. Satellite altimetry is a major tool in the workshop of geophysicists. Over oceans, altimetry provides data on the height of waves and of the sea surface itself, and allows wind information to be deduced. Paradoxically, when the sea is calm and highly reflective to an altimeter's radar—like during surface-smoothing oil spills or algae blooms—the backscattered waveform is highly distorted and often unusable; about 5% of altimetry data are thus affected. But the distorted data are still rich in structure. Jean Tournadre of the French Research Institute for Exploitation of the Sea, in Plouzané, France, noticed that some features were similar to those seen when a radar pulse is impacted by small atmospheric rain cells within the altimeter's 8- to 10-km wide "footprint." He and his colleagues then developed a model to analyze the distorted data in terms of small slick patches and applied the model to several different realistic cases. Now not only might previously useless data become valuable, but oil slicks and other phenomena may be trackable from space. (J. Tournadre et al., *J. Geophys. Res.* **111**, C04004, 2006.) —SGB ■