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Squeezing Light for Better Network Efficiency

December 14, 2009

Scientists at the University of Adelaide have discovered that light within optical fibers can be squeezed into much tighter spaces than was previously believed possible, a discovery that could lead to more efficient tools for optical data processing in telecommunications networks and optical computing.

Optical fibers usually act like pipes for light, with the light bouncing around inside the fiber. As the fiber size shrinks, the light becomes increasingly confined until the ultimate limit is reached--the point beyond which light cannot be squeezed any smaller. This point occurs when the strand of glass is just a few hundred nanometers in diameter, about one thousandth of the size of a human hair. Beyond this point, light once again begins to spread out.

The University of Adelaide researchers found that they can push beyond the ultimate size limit by at least a factor of two. They achieved this ability thanks to a pair of breakthroughs: a fresh theoretical understanding of how light behaves at the nanoscale and the use of a new generation of nanoscale optical fibers being developed at Australia’s Institute for Photonics & Advanced Sensing (IPAS).

The researchers claim that besides leading to increased network efficiency, their discovery will likely open the door to several new optical fiber applications. "By being able to use our optical fibers as sensors--rather than just using them as pipes to transmit light--we can develop tools that, for example, could easily detect the presence of a flu virus at an airport, could help IVF (in vitro fertilization) specialists to determine which egg should be chosen for fertilization; could gauge the safety of drinking water, or could alert maintenance crews to corrosion occurring in the structure of an aircraft," says Tanya Monro, a University of Adelaide professor and an IPAS fellow.

Monro says the discovery, made by Shahraam Afshar, another IPAS research fellow, represents "a fundamental breakthrough in the science of light." Yet another IPAS researcher, Yinlan Ruan, recently created what is thought to be the world's smallest hole inside an optical fiber--just 25 nanometers in diameter. "These breakthroughs feed directly into our applied work to develop nanoscale sensors, and they are perfect examples of the culture of research excellence that exists among our team members," Monro says. "They will enable us to study the applications of light at much smaller scales than we've ever thought possible. It will help us to better understand and probe our world in ever smaller dimensions."

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