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IR Wireless Signals High Bandwidth at Low Power

Wireless infrared local-area networking is a flexible and economical alternative to hardwired interconnections. Unlike radio frequency transmission, both narrow- and wide-angle infrared communications can support high data rates, but at a cost. Narrow-angle transmission requires precise alignment of transmitter and receiver, while wide-angle transmission demands high power.

Mohsen Kavehrad and Svetla Jivkova, researchers at Pennsylvania State University in University Park, have illustrated a model that combines elements of both narrow- and wide-angle systems to deliver high data rates with low power. Prototype components have been constructed, and Kavehrad plans to demonstrate a system prototype. Results described are drawn from computer simulation of room, transmitter and receiver.

Rather than illuminating an entire room, the transmitter integrates an eight-level computer-generated hologram coupled to an IR diode to create a 10 x 10 array of 5-cm spots on the ceiling. The spots are small, allowing their intensity to be kept relatively low; the receiver's narrow 7° field of view helps filter background illumination.

As long as the angle of incidence does not exceed 60°, each spot acts as a secondary lambertian source, reflecting at a constant intensity, regardless of the angle from which it is viewed. The spot-to-spot intensity variation is less than 1.5 percent.

The receiver uses a multibranch configuration with several adjacent small fields. It is constructed from a holographic curved mirror with a 6-mm-diameter silicon photodiode positioned at its focus. The mirror functions as a 20-nm bandwidth spectral filter.

The transmission spot array and the receiver field of view are designed to ensure that only one transmission spot is contained within the field, which eliminates the problem of multiple signal paths. Multiple reflections still can limit the bandwidth of the system, but with appropriate signal encoding and modulation, data rates of hundreds of megabits per second are achievable with a transmitter that consumes well under 1 W.

Richard Gaughan

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