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## Miniature Cameras



the scene multiple times at high speed using an analog-to-digital converter placed within each pixel. This, said El Gamal, nondestructively measures the integrated charge. The initial time sample captures the brightest parts of the scene, while each subsequent time sample captures the darker parts. The length of the exposure is set at a level that permits the darkest image region to be estimated.

### Color perspectives

The scientists call the pixel design that incorporates the local analog-to-digital converter a digital pixel sensor. They believe that it opens up CMOS applications that people previously may not have considered using. For example, the sensor can capture a blur-free image of a propeller moving at 2200 rpm. El Gamal said that such enhanced image analysis opens the door for new or improved research applications in areas such as motion tracking, pattern recognition, study of chemical reactions and interpretation of lighting changes.

Camera makers are continually



**Figure 2.** This sensor differs from other CMOS-based imagers in that it digitizes at the pixel level. During a single exposure time, the sensor can obtain multiple representations at different exposures to enhance the image displayed. Courtesy of Stanford University.