



Hakki Refai

This guest blog comes from Hakki Refai, chief technology officer for Optecks, a TI DLP® Design House dedicated to developing products and solutions for applications utilizing DLP technology.

In today's world, 3D representations of objects and data are highly sought after and widely used tools for applications as diverse as manufacturing, data visualization, medicine and entertainment. But where do these models come from? One common source is advanced computer aided design (ACAD) software, which builds 3D objects by cutting and joining virtual blocks of material. The other common source, to which [DLP technology](#) can be readily and advantageously applied, is a 3D scanner, which uses one or more sensors and additional components to register and store information about the object's surface. This information can include the location of the surface in space, its texture, reflectivity, transmittance and possibly its color. A quality scanner rapidly produces accurate measurements of a wide range of objects with high resolution and minimal invasiveness, and is easy and cost-effective to use. DLP technology can be utilized to make high-quality scanners a reality.

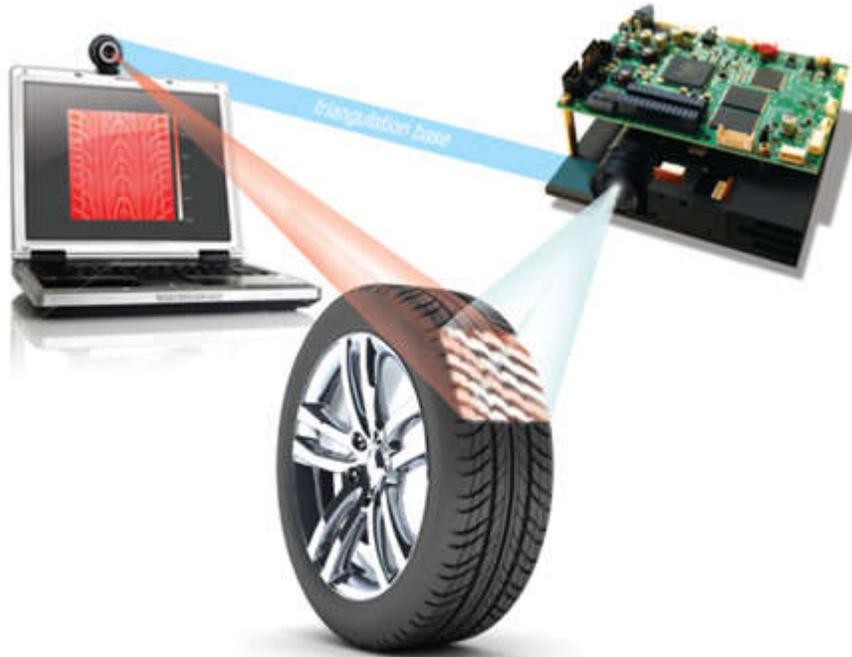
Did You Know?

3D scanning can be used in
archeology, architecture,
sculpture, fashion, virtual training
environments, security and
quality control?

So, how does the 3D scanning process work? Here are five basic steps:

1. **Acquisition:** The properties of the object are measured via sensors and other elements and the measurements are stored for later processing. The acquisition process is often carried out in multiple stages from a variety of perspectives to ensure that all relevant details are captured.
2. **Registration:** The data sets obtained from each acquisition stage are referred and aligned within a consistent frame of reference. This establishes the relationships among the measurement sets that helps fuse the measurements into a cohesive model.
3. **Generalization:** During acquisition, it is impractical to measure every single point on a continuous surface, and thus measurement data is discrete or discontinuous. To construct a continuous surface representation, algorithms have been developed to correctly interpret the measurements and extrapolate or fill in the surface between data points.
4. **Fusion:** The measurements from multiple stages are combined into a single object. This step can happen before or after generalization. Several iterations of steps 3, 4 and 5 are needed to produce an accurate model.
5. **Optimization:** The model is reformatted for optimal use in the target application.

The 3D scanning process works most effectively if the number of measurements per unit area, known as the *sampling density*, is high and can be obtained quickly. Active triangulation is commonly used (e.g. *Kinect*) to meet this goal. A source of known orientation and position illuminates the object with a pattern of light designed to reveal details of interest. A camera of known position and orientation captures an image of the pattern. Triangulation is used to then locate each point of the pattern in space, producing grid points of the object's surface. If many different high-resolution patterns can be displayed in a very short time, a highly accurate 3D model will result.



It is *here* that DLP technology provides differentiated advantages. These include:

1. Small digital micromirror device (DMD) pixel sizes produce resolutions with high light intensities for excellent performance.
2. When coupled with different-colored light sources, the effects of object color on the acquisition process are minimized, and color-encoded data can be rapidly acquired.
3. The rapid frame rate of the DLP systems can produce up to 32,500 patterns per second, achieving high acquisition speeds and allowing quick and accurate system calibration.
4. Pattern type, color and resolution can be changed in one or only a few frames to rapidly provide many diverse measurements that can result in high accuracy and detail.

Want to learn more about 3D scanning? Check out these resources:

- *Highly Scalable TI DLP Technology for 3-D Machine Vision* [whitepaper](#)
- *3D Scanning & Metrology* [whitepaper](#)
- DLP 3D Machine Vision [solutions](#)

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