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Improved Imaging Techniques in Medicine, Security, and Other Applications

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Technology description

Summary

Each year in the United States, more than 500 million medical image scans are conducted to diagnose myriad health issues, including heart disease, cancer, and stroke, which are among the top causes of death in Americans. But often these scans do not yield a full picture; this can be due to a limited viewing-angle range, limited data, or physical limitations of the imaging hardware. Existing corrections for these issues are often too technique-specific to be useful or, in the limited-data cases, just don't work. Researchers at the University of Chicago have developed an image-reconstruction methodology that works across multiple imaging techniques and corrects for several types of imaging problems.

Description

In medical imaging and other applications, constructing a visual image is a mathematical process performed by computer. Data collected by an imaging machine is fed to a computer and assigned a mathematical function that describes it. Then a second "converter" function, called a "linear transform," is applied to it, turning 3D data into a 2D image. In many practical situations, however, only limited data can be collected. As a result, the output from the linear transform isn't fully known and the image is poor. Described here is a general six-step computer algorithm for accurately recovering images from partial linear transforms of partial data. First, using the actual, available data, a computer produces an initial estimated image using a conventional reconstruction method. Second, using the partial linear transform, a second data set, the "estimated measurements," is generated. Third, the computer uses the differences between the actual data and the estimated measurements to generate another estimate of the image, called estimate one. Fourth, the computer selects only those data points with non-negative values, preventing problems later on. Fifth, yet another estimated image, estimate two, is computed from a statistical analysis of estimate one. Step six loops back to step two, applying the known linear transform to estimate two instead of the initial estimate. Steps two through six are repeated multiple times, producing several "new" estimate ones and estimate twos, until the two estimates converge. Either of the final versions of estimate one and estimate two can be used as the completed estimated image, although two will be slightly "smoother" than one.

Institution

University of Chicago