AbstractID: 7848 Title: Imaging With Distributed Source Arrays

Imaging with Distributed Source Arrays

While the vast majority of x-ray imaging procedures use a single x-ray source, a growing number require measurement of x-ray transmission from different locations. These exams are generally performed by moving a single x-ray source to many positions. Examples include computed tomography (CT) and tomosynthesis. At the same time, several technologies are now becoming more available that enable to construction of source arrays, i.e., a large number of sources that can be turned on in sequence. The purpose of this presentation is to explore the capabilities and benefits of imaging with these source arrays.

In CT, small deflections of the x-ray focal spot (on the order of a millimeter) have been used to improve data sampling. Multiple sources or much larger deflections (on the order of centimeters) in the axial direction can be quite useful for increasing the thickness of the imaging slab in a single scan while reducing cone beam artifacts. Distributing sources in the circumferential direction can dramatically reduce the mechanical rotation needed to obtain a complete data set and therefore can shorten the scan time. The recently introduced dual source CT system is the most recent incarnation in this direction. The limiting case is CT scanning with no mechanical rotation, as in electron beam CT. An array of sources separated in the circumferential direction can also be used to reduce the size of the detector array. This can lead to a reduction in detected x-ray scatter and perhaps in the adoption of more advanced detector technologies. It also provides a reasonable method for optimization of the incident intensity distribution, thereby potentially reducing the dose to the patient while also tailoring the distribution of quantum noise across the image.

In tomosynthesis, as in CT, measurements from different directions are used to produce tomographic information, albeit with imperfect spatial separation due to data insufficiency. Nonetheless, tomosynthesis can be powerful in many settings where obtaining complete CT data is difficult, and is gaining popularity. Data acquisition with mechanical motion of a single source is limiting both in the needed imaging time and in the number of projections that can be obtained. A small number of projections makes the blurring function (the “crosstalk” from one location to another from imperfect spatial separation) very discrete and potentially distracting to the viewer. Source arrays can be used to produce tomosynthesis images with very short imaging time and smooth blurring functions, both of which are preferred.

Thus, there are significant benefits from the use of distributed sources. The author anticipates that these source arrays will become more widely adopted.

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Educational objectives:

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1. become familiar with the types of source arrays and their capabilities
2. understand the benefits of source arrays in computed tomography
3. understand the benefits of source arrays in tomosynthesis