Novel X-ray Imaging Techniques for Clinical Medicine

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Synchrotron radiation is an ideal x-ray source which is suitable for developing new x-ray imaging techniques. Use of monochromatic x-rays and "phase contrast" effects makes it an attractive, new approach to radiology. A number of x-ray imaging techniques have been developed and reported, which are mainly tested on small animals. Techniques whose advantage lies in high spatial resolution tends to accompany a high x-ray dose which is undesirable for human use, but the dose can be reduced by getting higher contrast using a new imaging technique.

When applying a new technique to a human body, an x-ray beam from a synchrotron is often not ideal: the beam is too small, the energy too low, the flux too low (especially when it is monochromatized), and so on. Thus, there are two approaches to transfer technology to clinical medicine. One is to use SR with technical modifications, the other is to use a conventional x-ray source and make a system that can be installed at a hospital. The former approach was taken for coronary angiography (SSRL, NSLS, DESY, ESRF, PF-AR) and mammography (Elettra), while the latter was taken for the Konica-Minolta Phase-contrast Mammography system.

When a monochromatic x-ray is prerequisite for the technique, SR is the only option. The basic problem of the SR system is the construction cost of a synchrotron, which limits the number of available sites. The necessity to build a SR facility with a hospital, or rather a hospital with a synchrotron, has been pointed out. For a hospital system, the biggest difficulty is often found in the x-ray generator because the new imaging techniques tend to require a small source size. Despite these difficulties, many efforts are being made to utilize new imaging techniques in clinical medicine.