SPECTRAL MICROTOMOGRAPHY USING THE MARS-CT

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The aims of this work are visualization of unknown object and material identification using spectral computed tomography. It is very important to study this processes, as it may lead to the development of new innovative approaches in the biomedical research (example, for tissue identification) and in the geophysical studies (example, ore composition).

Keywords: MARS-CT, CT, X-ray, Timepix detector, 3D visualize, atomic number, pixel.

Many of us heard about computed tomography (or simple CT) as an indispensable imaging method in clinical routine. CT produces a volume of data to demonstrate various bodily structures based on their ability to absorb the X-ray beam. As you know, X-ray radiation is of electromagnetic nature. And CT operates by using an X-ray tube that rotates around the object. As a result, we get a picture. But for the other purpose, such as material testing and analysis it's more useful a miniaturized design of the cone beam CT, which called Micro-CTs. The X-rayed measuring field, usually as small as $2cm^3$ in volume, is so small that medical applications might seem to be ruled out. But we can use it in human medicine, example, for analysis of trabecular structures in bones. Micro-CTs are also ideal scanners for radiological examinations of small animals.

In our work we use MARS-CT scanner. The abbreviation MARS means *Medipix All Resolution System.* The key feature of the MARS-CT is the ability to measure quantitative information about the elemental, molecular information of tissues and contrast materials on the basis of their attenuation properties. For this purpose, in our MARS-CT was installed gallium arsenide-based 1 mm-thick Timepix detector + Fitpix readout interface with more than 65 thousand pixels, 1 energy threshold per pixel, microfocus X-ray tube. The gantry is surrounded by the lead shield. The scan procedure is fully automatic. The sample stays motionless. The size of a sample may be up to the diameter of 10 cm and up to the length of 30 cm. The bias voltages for the sensor were 700 V and 500 V.

The MARS-CT scanner and image processing are used to obtain practical skills of making scans. And we were working on two different tasks. The first one was to identify an unknown object. So, we scanned the object by the MARS CT scanner, and then we got shadow projections. Then, we processed the obtained projections using an imaging processing software to reconstruct and 3D visualize an image. The second task of our project was to study the ability of MARS scanner and to identify different materials with different concentrations and atomic number. In this regard, we used a phantom of 9 falcon tubes which have the materials under study. We studied this under two different applied bias voltages to the sensor (500 V & 700 V). Using the same steps in the previous slide, we were able to calculate the linear attenuation coefficients which is related to the energy. The result are following:

1. The multi-energy spectral CT system has the ability to discriminate nine materials from each other. The addition of a color spectrum to the spatial resolution provided by MARS-CT scanner gives significantly more information.

2. The highest voltage that the detector can withstand is 700 V, and this may result in producing a good quality image. On the other hand, as we decrease the voltage to 500 V, it gives lower quality.

3. In the terms of field size, it doesn't make any difference for the results.

BIBLIOGRAHY

1. *Тихонов А. Н., Арсенин В. Я., Тимонов А. А.* Математические задачи компьютерной томографии. – Москва: Наука, Гл. ред. физ.-мат. лит., 1987. – 160 с

2. *Хермен Г.* Восстановление изображений по проекциям: Основы реконструктивной томографии. – Москва: Мир, 1983. – 352 с.