The resolution recovery - Application to various CT systems.

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Abstract

The degradation of image due to the finite size of sensing device has been one of the problems to all of the digital imaging systems. The improvement of the spatial resolution has been attempted by "differential method" with fixed sensor size and finer sampling. The computer simulations were carried out for the cases of PLF system (Parallel Linear Fan-beam) and SR(Stationary Ring) system and the results are presented.

In most of the imaging systems, the object is scanned with the sensing devices and sampled data is obtained. Due to the finite sensor size, however, the spatial resolution is usually limited.

The obtained data is not the value of the exact position X, but the averaged strip integral between X-T/2 and X+T/2, T being the sensor width.

Therefore the finer sampling alone can not improve the resolution. Here we have applied differential method to improve the resolution of "blurred image", similar to the recovery of the motion-blurred picture.

The principle is as follows;

$$g(x)=1/T \int_{x-T/2}^{x+T/2} f(y)\, dy$$

where $f(x)$ is original data and $g(x)$ is overlap-sampled data.

By differentiating both sides with respect to x, we have the following relations;

$$g'(x)=1/T(f(x+T/2) - f(x-T/2))$$
$$f(x)= f(x-T) + T\cdot g'(x-T/2) .$$

If the sampling interval is dx, f(x) becomes

$$f(k\cdot dx)=f(x\cdot dx-T) + T\cdot g'(k\cdot dx-T/2) .$$

$$x=x\cdot dx \text{ , where } k=1,2,3, \cdots$$

If we set T/dx=Nd (even integer), then f(k) finally becomes,

$$f(k)=f(k-Nd) + T\cdot(g(k-Nd/2)-g(k-Nd-1))$$

As a result, if we know f(1), f(2), ... f(Nd), the rest of f(k) can be calculated for k=Nd+1, Nd+2, ...

For Nd=4, we can obtain the improved spatial resolution being comparable to the resolution of the quarter-width sensor system. By increasing Nd, we will be able to improve the spatial resolution of the image up to the point where "Statistics" limits the resolution.

We have applied this technique to improve the system resolution of the PLP and SR systems, which are believed to be the most up-to-date CT systems presently known.

REFERANCES

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