# Pengembangan Algoritma Perhitungan *Modulation Transfer Function* (MTF) secara Radial pada Fantom *Polymethyl Methacrylate* (PMMA)

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## Abstrak

Pengukuran *modulation transfer function* (MTF) menngunakan fantom polymethyl methacrylate (PMMA) kepala sudah diperkenalkan sebelumnya. Akan tetapi, pengukuran menggunakan *region of interest* (ROI) pada bagian tepi atas fantom. Tujuan dari penelitian ini adalah mengukur MTF radial secara otomatis menggunakan fantom PMMA kepala. Fantom PMMA kepala dipindai dengan CT dalam mode axial. Software pengukuran MTF radial secara otomatis dibuat dengan MATLAB. Tahap-tahap pengukuran tersebut dimulai dengan segmentasi dan penentuan pusat citra. Dari pusat fantom, dibuat garis-garis secara radial melalui tepi fantom. Garis-garis yang terbentuk merupakan ROI pengukuran MTF. *Profile* ROI diambil dan dirata-rata untuk mendapatkan satu *profile* yang disebut dengan *edge spread function* (ESF). ESF didifferensialkan membentuk *line spread function* (LSF). LSF ditransformasi *fourier* untuk mendapatkan MTF. MTF dari ROI radial dibandingkan dengan MTF dari ROI persegi, metode homogenisasi, variasi ukuran ROI persegi panjang, dan filter yang berbeda. Algoritma pengukuran MTF radial secara otomatis telah berhasil dikembangkan dengan MATLAB. Nilai MTF 50% untuk ROI persegi dan radial adalah masing-masing 0.37 ± 0.00 *cycles* / mm and 0.37 ± 0.00 *cycles* / mm. Nilai MTF 10% untuk ROI persegi dan radial adalah masing-masing 0.69 ± 0.01 *cycles* / mm and 0.69 ± 0.00 *cycles* / mm. Perbandingan nilai MTF dengan metode homogenisasi dan ROI radial adalah sebanding. Apabila dibandingkan dengan variasi ROI persegi panjang nilai MTF radial sebanding dengan menggunakan ROI 41 x 41 piksel. Algoritma untuk pengukuran MTF radial dapat digunakan untuk citra berfilter FC13. Sehingga ROI radial ini dapat digunakan untuk mengukur nilai MTF secara akurat.

**Kata kunci** : computed tomography (CT), edge spread function (ESF), line spread function (LSF), modulation transfer function (MTF), region of interest (ROI), fantom PMMA

# Development of Radial Modulation Transfer Function (MTF) Calculation Algorithm on Fantom Polymethyl Methacrylate (PMMA)

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## Abstract

The measurement of modulation transfer function (MTF) using a head polymethyl methacrylate (PMMA) phantom has been introduced previously. However, measurement is performed using a square region of interest (ROI) at the upper edge of phantom. The purpose of this study is to automatically measure radial MTF using a head PMMA phantom.The head PMMA phantom was scanned using CT scanner in axial mode. Software for an automated radial MTF measurement was developed with MATLAB. The steps of automated measurement were started with segmentation and determination of the center of the image. From the center of the phantom then lines were drawn radially so that it passed over the edge of the phantom. These lines indicated the ROIs for MTF measurement. The profiles of the ROIs were taken. The profiles were then averaged to obtain a single profile called edge spread

functions (ESF). The ESF was differentiated to get line spread function (LSF). The Fourier transformation was applied to the LSF to get the MTF. The MTFs resulted from the proposed method were compared to those obtained using a square ROI, Homogenization method, Rectangular ROI sizes, and filters. The software for an automated radial MTF using a head PMMA has been proposed and successfully developed using MATLAB. The MTF 50% values for the square and radial ROIs are 0.37 ± 0.00 cycles / mm and 0.37 ± 0.00 cycles / mm, respectively. The MTF10% values for the square and radial ROIs are 0.69 ± 0.01 cycles / mm and 0.69 ± 0.00 cycles / mm, respectively. Comparison of MTF value with homogenization method and radial ROI is comparable. As the radial MTF is compared to the rectangular ROI variation, the radial MTF value is comparable to using an ROI of 41 x 41 pixels. This software for automated radial MTF can be used for FC13 filter. So this radial ROI can be used to measure the MTF value accurately.

**Keywords**: computed tomography (CT), edge spread function (ESF), line spread function (LSF), modulation transfer function (MTF), region of interest (ROI), PMMA phantom

**Pembimbing Akademik**

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