Comparing the Matrix and EPID Flatness/Symmetry/Output Measurement

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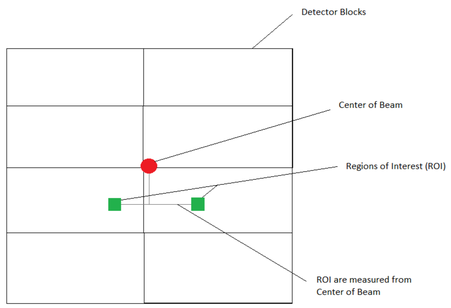
Introduction

In delivering patient dose, it is important to know that the beam shape, and the output will remain consistent over time. To ensure this, QA is done on the machine. However, this requires the use of a 2D ion chamber array matrix (or matrix device), particularly when it comes to flatness and symmetry measurements.
As a result, it is only limited to be used monthly. In this project, the use of EPID panel to compare flatness, symmetry and output.

Method

When measuring output, one has to compare the dose measurements from both the matrix device and the EPID panel. To do this, a region of interest is drawn over the center of the beam in this manner.



This is to reduce variations in the beam shifting in the EPID panel, while minimizing the chances that a single region of interest will span multiple detector blocks. It's then averaged out. A few other corrections needed includes having to correct for large changes, including any seasonal changes that was observed in the matrix device.

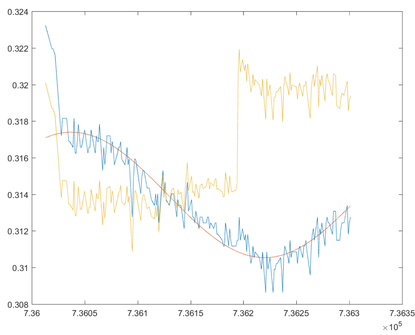
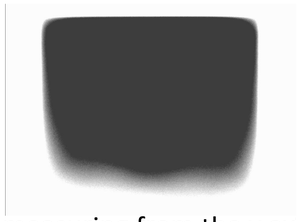


Figure 1. Plot of the output measured by the matrix device. The blue line represents the data before the correction in the change of output, while the yellow line represents the final corrected output. The red line is a sine curve fitted to the blue line.

Method (continued)

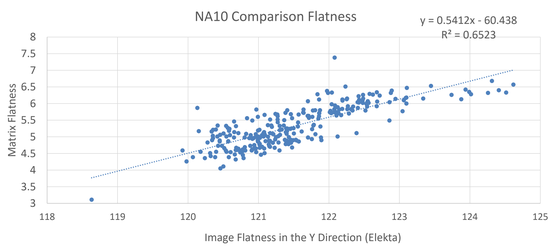
As for the output given by the flatness and symmetry measurement, it is important to determine the use of things. To keep consistency, the Elekta system (also known as IEC 60976:2007) of measuring flatness and symmetry is used.
To complicate things, the open field image is actually 2 images, where the 1st image measures from y = -20cm to 0, and the 2nd image measures from y = 0 to 20 cm. As a result, the image looks misshaped:



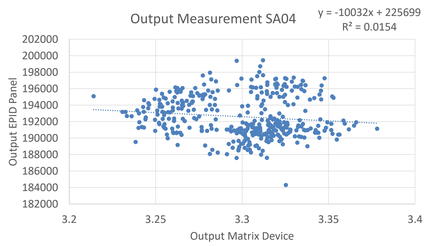
To compensate, measuring from the y axis required "stitching" the two images together. A Gaussian filter was then applied, then a sample line (5 pixels wide, and both traverse and longitudinal) is drawn, averaged out, and had the Savitzky–Golay filter applied. This is repeated for the other image. The entire image is then linearly regressed with the matrix measurements.

Results

The results showed that there is only a moderate correlation in symmetry measurements in the flatness measurements between the matrix device and the EPID Panel it ranged from 0.45 to 0.71. For example, on one of the machines, the r^2 value was 0.65:



However, the output and symmetry measurements are not correlated at all:



Discussion

There is one factor that may effect the reading on the output measurement, and that is the measurement. For one, there could be some form of long term deterioration in either the EPID panel, or the matrix device. This could result in But until more information on the rate of EPID panel and matrix panel deterioration, it will be difficult to determine whether the EPID panel will be an acceptable substitute

The largest problem when it came to the symmetry measurement was that there was not enough variation in the symmetry, to the point where the day to day changes in the measurement of symmetry could be caused by the measurement error.

Next Steps

Further analysis on the decay of matrix device is ideal, to rule out the decay of the matrix device as the cause of the lack of correlation between the two output measurements. Also, the symmetry calculation should be further improved to improve the correlation factor.

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REFERENCES

[1] *Medical electrical equipment - Medical electron accelerators - Functional performance characteristics* IEC 60976:2007 Accessed February 26, 2018 https://webstore.iec.ch/publication/408

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