PD-0142
Efficient daily linac QA of MLC, block and dose using EPID images of warm-up fields
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**Purpose/Objective:** An efficient and comprehensive tool for daily QA of the linac was developed based on EPID images. The objective was a routine procedure that
1) Makes clinical use of the daily linac warm-up time
2) Reliably checks the EPID, MLC, block and dose output
3) Is independent of the type of linac- or EPID
4) Provides warnings when out of tolerance
5) Allows sufficient error analysis and time trend detection
6) Can be easily measured and analysed by RTTs
7) No phantom needed
8) Takes < 15 minutes

**Materials and Methods:** The Daily Linac QA tool was developed in Matlab. EPID images are acquired of the 14 fields irradiated during warm-up of the linac. The images are then automatically analysed, beginning with a check of the EPID, followed by geometric tests of the block and MLC, finishing with measurements of the dose output. The tool was configured to immediately present results to the user (RTT), with a conclusion whether or not the linac can be used to treat patients.

![Image](image.png)

Figure 1: Overview of all acquired fields: (1) dark current (2) 24x24 cm, col 90° (3) leaf-identification image (4) leaf-bank A opposite block (5) leaf-bank B opposite block (6) half-field leaf-bank A (7) half-field leaf-bank B (8) half-field block A (9) half-field block B (10) 10-segment picket fence test (11) 24x24 cm, 2x4 MU, 6 MV (12) 24x24 cm, 2x4 MU, 10 MV (13) 24x24 cm, 50 MU, 6 MV and (14) 24x24 cm, 50 MU, 10 MV.

**Results:** The Daily Linac QA tool takes 15 minutes and is performed by RTTs on each linac during warm-up. Warnings are automatically sent to physicists when tolerances are exceeded. An overview of the resulting test analysis is presented in the table below.

<table>
<thead>
<tr>
<th>Test</th>
<th>Images used</th>
<th>Analysis description</th>
<th>Tolerance</th>
</tr>
</thead>
<tbody>
<tr>
<td>EPID dark current</td>
<td>1</td>
<td>central-axis grey-level without irradiation</td>
<td>-</td>
</tr>
<tr>
<td>EPID sagging</td>
<td>6,7,8,9</td>
<td>comparison of EPID centre with constructed beam centre</td>
<td>2 mm</td>
</tr>
<tr>
<td>Leaf positions</td>
<td>3</td>
<td>EPID pixel rows of leaf centres + determining ref. leaf</td>
<td>-</td>
</tr>
<tr>
<td>Leaf minor bank A&amp;B</td>
<td>4/5</td>
<td>gap between leaves and opposing block, rel. to the ref. leaf</td>
<td>0.75 mm</td>
</tr>
<tr>
<td>Leaf-bank offset Block offset</td>
<td>6,7,8,9</td>
<td>over-/undershoot in profile of summed half-fields</td>
<td>7.5%</td>
</tr>
<tr>
<td>Block-limited field size</td>
<td>2</td>
<td>leaf size from horizontal profile of 2x4x2cm field</td>
<td>1.5 mm</td>
</tr>
<tr>
<td>Picket fence test</td>
<td>10</td>
<td>largest over-/undershoot for all leaves and all abutting segments</td>
<td>11%</td>
</tr>
<tr>
<td>Collimator rotation</td>
<td>8</td>
<td>field-edge angle of half-field</td>
<td>0.5°</td>
</tr>
</tbody>
</table>

Conclusions: The Daily Linac QA tool meets all the objectives in terms of reliability, independence, safety, detection, simplicity and efficiency. The tool has been used clinically in our hospital for 3 years with great success, and has proved to be a valuable aid to identify points of attention for linac maintenance.

PD-0143
4D cone-beam computed tomography combining total variation regularization and motion compensation
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**Purpose/Objective:** Breathing motion affects the image guidance of lung tumors when projection images are acquired using a slowly rotating cone-beam (CB) CT X-ray system while the patient breathes. Advanced methods have been developed to achieve streak-free and blur-free reconstructions, most of which are either based on motion compensation, or on regularization using some a-priori information.

This paper introduces a method that combines both approaches, called Motion Compensated ReconCOnstructIoN using Spatial and Temporal Regularization (MC ROOSTER), and describes how it compares with its regularization-only counterpart (ROOSTER), with Motion Compensated FDK (MC FDK), and with respiration-correlated FDK.

**Materials and Methods:** ROOSTER is a 4D reconstruction algorithm that alternates between several optimization goals: forward and back projections to match the measured projection data, positivity enforcement, restriction of motion to a motion mask, spatial Total Variation (TV) denoising, and temporal TV denoising.

A 4D Deformation Vector Field (DVF) can be extracted from the 4D planning CT, and used to improve the reconstruction. MC ROOSTER takes advantage of this 4D DVF by performing the temporal TV denoising on warped volumes. All