On a New Approach to Reconstruct the Patient Dose from Phantom Measurements

Background
The development of complex radiation treatment schemes emphasizes the need for advanced QA analysis methods to ensure patient safety. One such tool is the Delta4 DVH Anatomy software, where the patient dose is reconstructed from phantom measurements. Deviations in the measured dose are transferred to the patient anatomy and their clinical impact is evaluated in situ. Results from the original algorithm revealed weaknesses that may introduce artefacts in the reconstructed dose. These can lead to false negatives or obscure the effects of minor dose deviations from delivery failures, see for example [1].

As a means to address said weaknesses, a new patient dose reconstruction algorithm (DRA) has been developed.

Method
The main steps of the improved DRA are:

1. The dose delivered to a phantom is measured in a number of detector positions.
2. The measured dose is compared to an internally calculated dose based on TPS calculations.
3. The dose difference is used as input to a patient dose correction calculation routine.
4. The resulting fluence difference is used as input to a patient dose correction calculation routine.
5. Finally, the patient dose is reconstructed by adding said patient dose correction to the planned patient dose.

Conclusions
The improvements in the dose reconstruction algorithm leads to a reduction in non-physical artefacts in the reconstructed patient dose. As a consequence, the possibility to detect deviations in the dose delivered to the patient is improved.

Results

- **Bar Pattern**
  - This case is reported in [1]. A Plastic Water slab is irradiated with a bar pattern shaped field. The delivered dose has strong gradients in the penumbra regions.

- **H&N patient**
  - The H&N patient has a target in the upper thorax region. The target surroundings consists of inhomogeneous tissue such as bone and lung tissue.

- **Prostate patient**
  - The prostate patient has a target situated in the pelvic region. The surroundings of the target consists of fairly homogeneous tissue.

Results from the phantom measurements are compared to the planned patient dose.

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<thead>
<tr>
<th>Phantom DRA</th>
<th>Old Patient DRA</th>
<th>New Patient DRA</th>
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<tbody>
<tr>
<td>Phantom DRA</td>
<td>99.7%</td>
<td>72.9%</td>
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<tr>
<td>Phantom DRA</td>
<td>92.1%</td>
<td>72.2%</td>
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<tr>
<td>Phantom DRA</td>
<td>92.1%</td>
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References: