Beam modeling of Elekta Agility MLC for Monte Carlo and Collapsed Cone Convolution computational algorithms in Monaco treatment planning system.

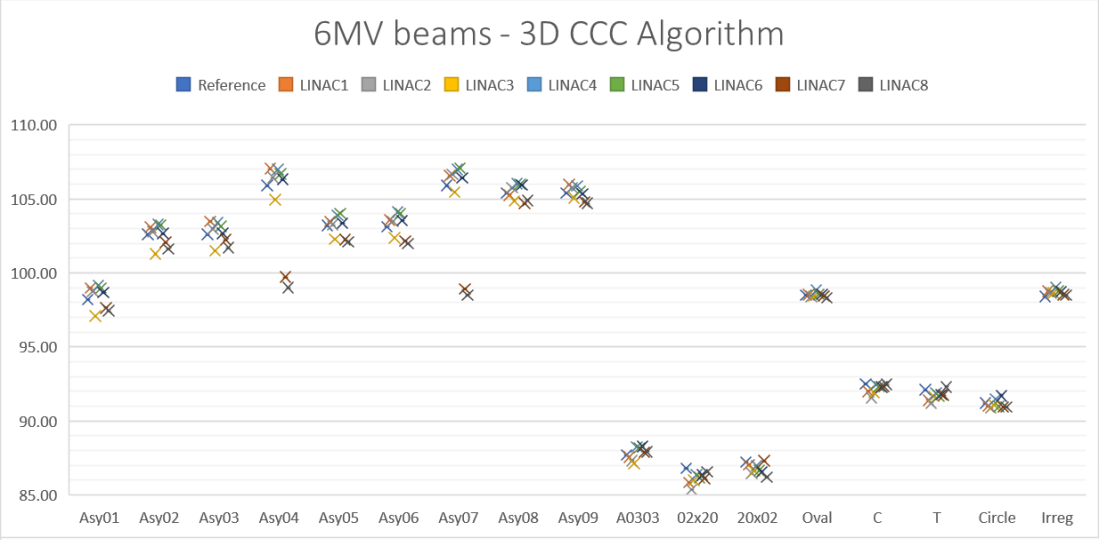
Virag Vasile Petru[1,2], Ghemis Diana Maria[1,2]

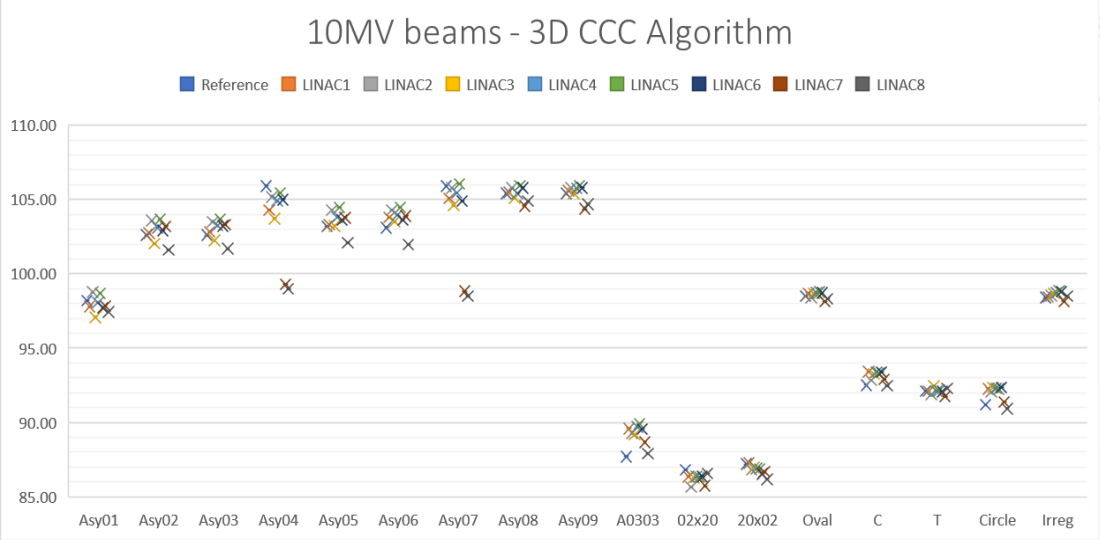
[1]West University of Timisoara, Faculty of Physics, Timisoara, Romania

[2]MedEuropa, Oncology and Radiotherapy Center, Oradea, Romania

Introduction

- After the commissioning process of the LINAC, beam modeling is the next step before clinical use.
- Monaco treatment planning system (TPS) uses two computational algorithms: Collapsed Cone Convolution and photon Monte Carlo.
- 8 beam matched linear accelerator from 4 different clinics were involved in this study.
- For 3D treatment planning, 17 asymmetrical and irregular fields were measured with Farmer, Semiflex and PinPoint ionization chambers, depending on the dimensions of the field.
- The fields were calculated in the TPS and the maximum tolerance admitted is +/- 3% from the TPS value.
- For IMRT and VMAT verification, 8 static and intensity modulated fields were used with the purpose to verify multileaf collimator parameters: leaf offset and leaf transmission. All fields were measured using a detector array with 1500 detectors and Octavius 4D system.

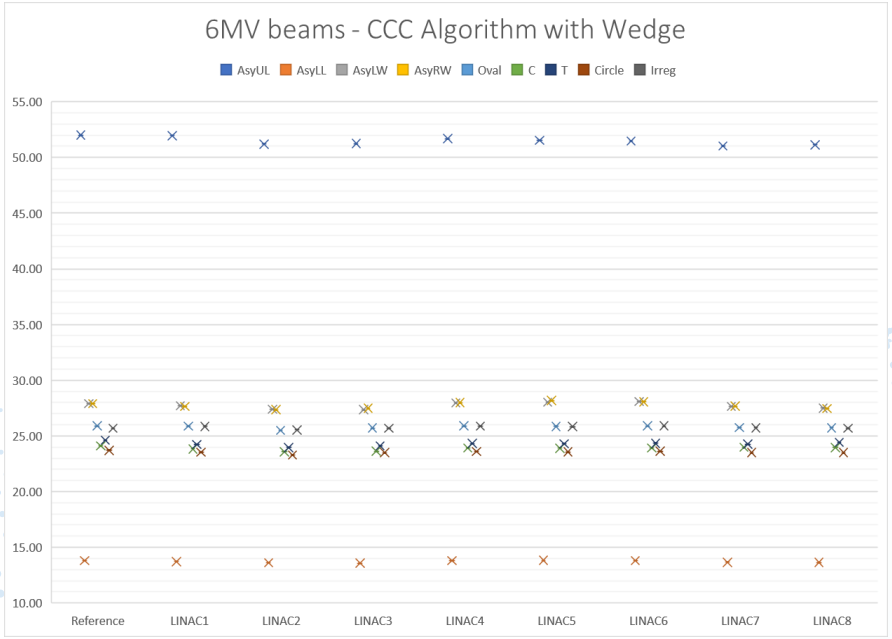


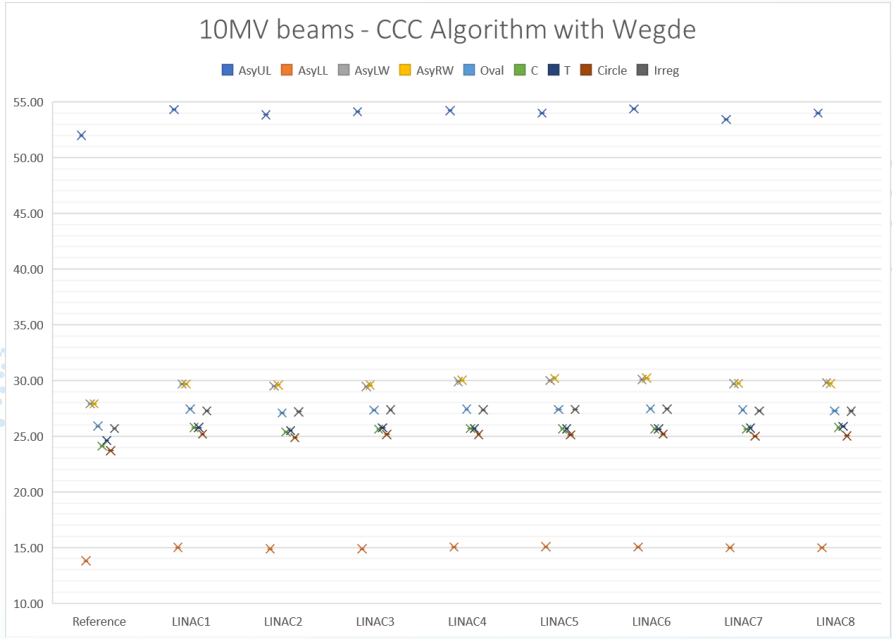


CCC Algorithm

- Collapsed Cone Convolution algorithm can be use only for 3D planning. All LINACS involved are able to deliver photon beams of 6MV and 10MV energy.
- 100MU were delivered for each field, equivalent to 1Gy at SSD 90cm and 10cm.
- Both energies shows good agreement with TPS system, with a maximum deviation of ±1.3%, for Asy04 and Asy07 fields due to beam shape situated at leaf limits, for both 6MV and 10MV energy.

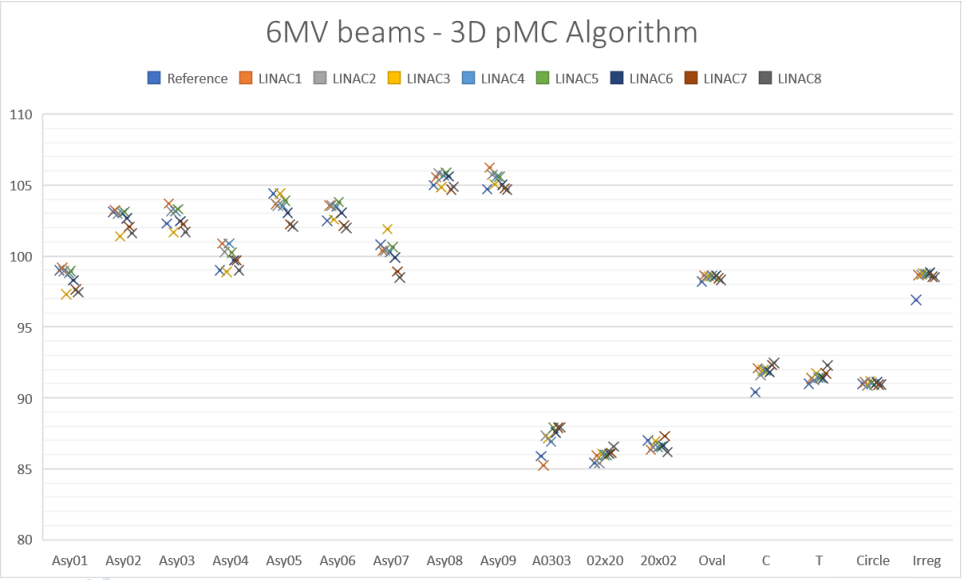
CCC Algorithm for Wedge filter

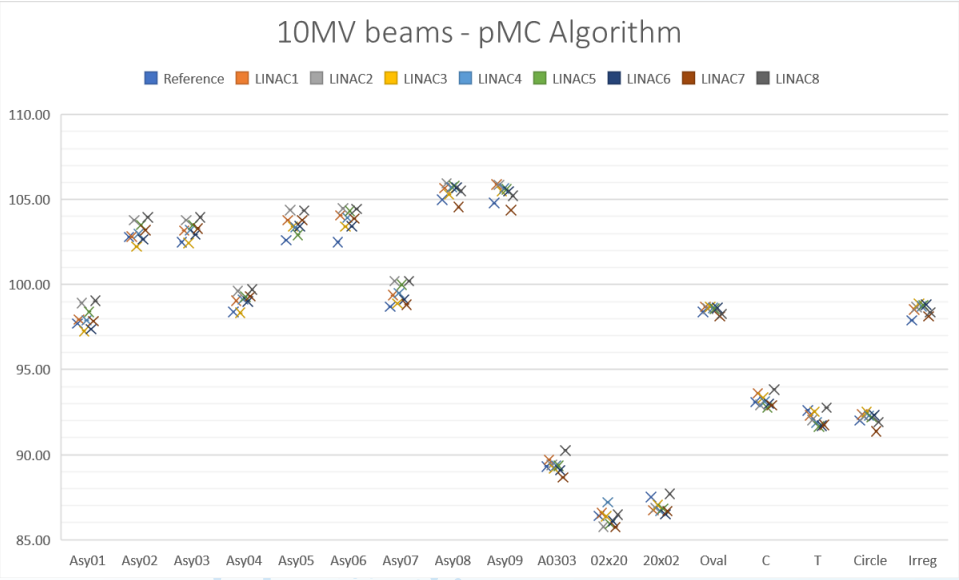




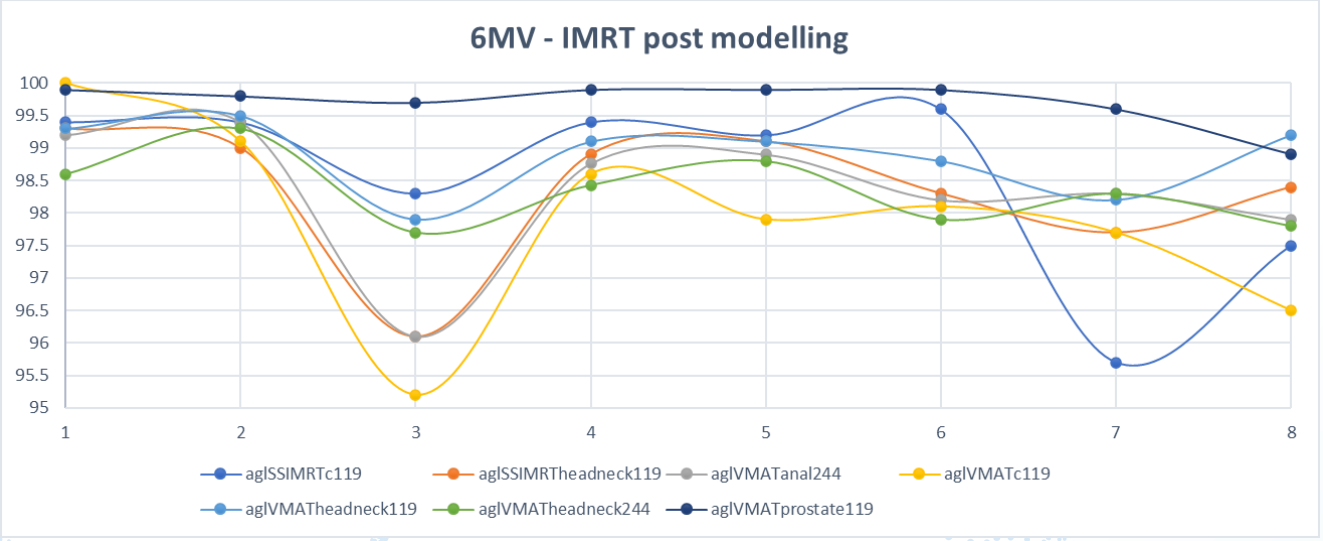
- **In the case of Wedge filter, the only computational algorithm available is Collapsed Cone Convolution.**
- **9 irregular fields were measured. 100MU were delivered for each field, equivalent to 1Gy at SSD 90cm and 10cm.**
- **The maximum deviation from reference can be seen for 6MV photon beams, +1.97%. For 10MV photons beams, the maximum deviation is +1.83%.**
- **Both energies shows good agreement with TPS system below the maximum admitted of ±3%.**

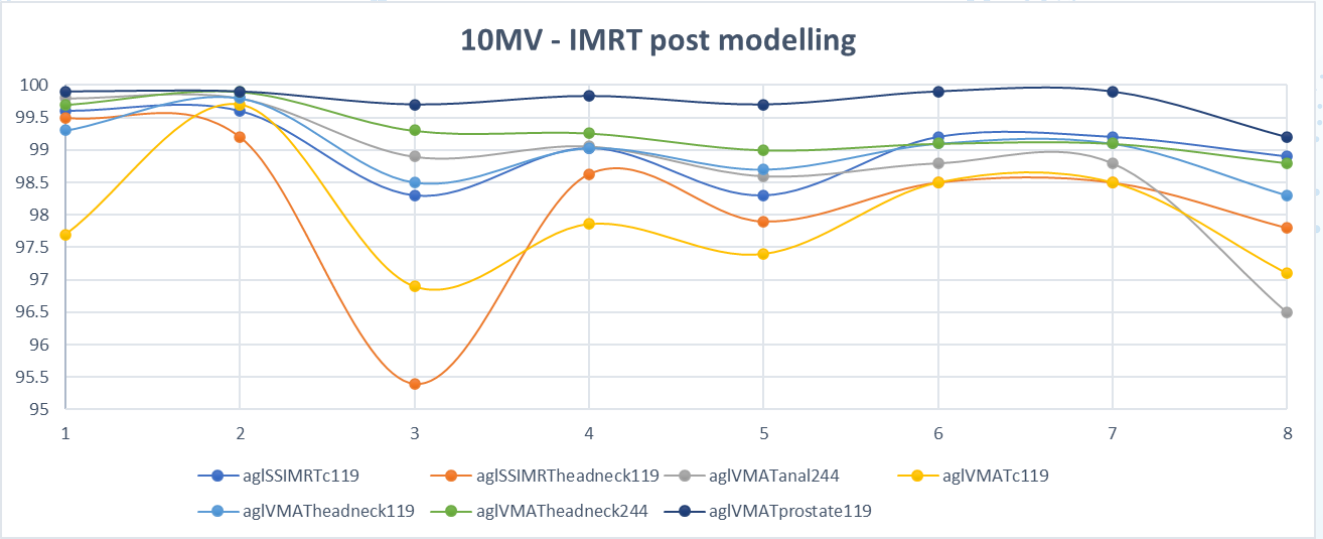
pMC Algorithm





- **Photon Monte Carlo algorithm can be use for both, 3D and IMRT/VMAT planning, with higher accuracy than CCC algorithm.**
- **The same 17 field with 100MU were delivered, with a maximum deviation of ±2.2% in case of 6MV energy.**
- **10MV photon beams shows good agreement with TPS measurements, with a maximum deviation of ±1.7%.**





IMRT/VMAT

- A set of 7 static and intensity modulated radiotherapy fields were used with the aim to verify Multi-Leaf Collimator (MLC) Agility parameter.
- PTW Octavius 4D system with 1500 detector array were used.
- All measured fields were analyzed using Gamma criteria 3mm distance to agreement (DTA) and 3% dose difference.
- Minimum requirement for passing the gamma analysis is 95% of the voxels should meet the criteria.
- All fields shows good agreement with results higher than 95%.

Conclusions

- The beam modeling was verified using a homogeneous phantom for point dose measurements, post modelling MLC parameters and patient QA plans.
- All plan parameters pass the gamma criteria with an average percentage higher than 95%.
- The 8 LINACS involved in this study are beam matched, therefore patient interchange is possible without replanning.