AbstractID: 5547 Title: Effects of intra-fraction motion on IMRT treatment with segments of few monitor units

**Introduction:**

Intra-fraction motion can affect the delivered dose distribution in radiotherapy. This is a concern in IMRT because of potential interplay between the delivered fluence pattern and the patient's breathing pattern. A widely applied approach to model organ motion is the use of a probability density function (pdf) in IMRT-optimization. We assess if breathing compromises treatment with IMRT segments delivering only few monitor units (MU), where the delivery time of the segments will be of the order of the breathing period. Further, we assess the limitation of IMRT-optimization based on pdfs for incorporating organ motion in treatment planning.

**Methods:**

A motor-driven platform, which moves sinusoidally with a user-specified amplitude and a period of 4s for tumor motion was used. The measurements were performed for motion amplitude of 4cm in 4x4cm$^2$-10x10cm$^2$ open fields and dose-rate of 500MUmin$^{-1}$. The MUs delivered were 8 to 183MUs, corresponding to delivery times of 1s to 22s. The measurements were repeated for ten different initial phases.

**Results:**

The delivered dose to a moving target varies with initial phase and with segment delivery time. For very long segment times the delivered dose has a 1-2% spread with the initial phase. Therefore, over 30 fractions, the average dose delivered to the moving tumor will converge to the mean dose delivered over the breathing-period. For short delivery times, the delivered dose varies significantly with the initial phase. This is because the delivered dose becomes dependent on non-uniform dose and penumbra effects.

**Conclusion:**

Motion can compromise an IMRT treatment if the segment delivery time (1-12s) is of the order of the breathing period and motion occurs in a region of non-uniform dose. Since the delivered dose also depends strongly on the initial phase, for short delivery times, care is needed when modeling organ motion as a pdf in IMRT optimization.