PhD Thesis Title: Quantification of dosimetric uncertainties in lung stereotactic body radiation therapy
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Graduation Date: 13th of September 2021
Available Online: https://dadun.unav.edu/handle/10171/65036

ABSTRACT:

Stereotactic body radiation therapy (SBRT) of pulmonary lesions has been shown to safely deliver a high dose to the tumour in a small number of fractions while limiting exposure to healthy tissues. Nevertheless, geometric uncertainties associated with this treatment technique such as respiratory motion, daily anatomical variations (anatomical baseline shifts between daily and planned position) and the simultaneous movement between the tumour and the multileaf collimator during treatment delivery (known as interplay effect), influence the accuracy on the treatment effectiveness.

In this context, the goal of this work is to quantify the dosimetric impact of those geometric uncertainties in lung SBRT. To accomplish this, several methodologies have been implemented based on deformable image registration.

The findings of this study indicate that daily anatomical deviations in patient anatomy generally had a larger dosimetric impact than respiratory motion. Furthermore, this work suggests that the interplay effect can be a matter of concern for patients with highly irregular breathing patterns or for those who have prolonged breathing cycles, particularly when small field sizes are used for dose conformation.

The methodologies developed in this work would be highly beneficial for clinicians involved in treatment planning and delivery, since they allow for the evaluation of treatment robustness against the geometric uncertainties addressed in this study.

References to author publications that relate specifically to the dissertation:

1. ***Huesa-Berral C***, Juan-Cruz C, van Kranen S, Rossi M, Belderbos J, Diego Azcona J, Burguete J, Sonke JJ. Detailed dosimetric evaluation of inter-fraction and respiratory motion in lung stereotactic body radiation therapy based on daily 4D cone beam CT images. *Phys Med Biol*. 2022 Dec 20;68(1). doi: 10.1088/1361-6560/aca94d.
2. ***Huesa-Berral C***, Burguete J, Moreno-Jiménez M, Diego Azcona J. A method using 4D dose accumulation to quantify the interplay effect in lung stereotactic body radiation therapy. *Phys Med Biol*. 2021 Jan 27;66(3):035025. doi: 10.1088/1361-6560/abd00f.
3. Azcona JD, ***Huesa-Berral C***, Moreno-Jiménez M, Barbés B, Aristu JJ, Burguete J. A novel concept to include uncertainties in the evaluation of stereotactic body radiation therapy after 4D dose accumulation using deformable image registration. *Med Phys*. 2019 Oct;46(10):4346-4355. doi: 10.1002/mp.13759.