3rd ESTRO Physics workshop: Science in development

25-26 October 2019, Budapest, Hungary

Computational methods for clinical target volume definition

Chairs: Jan Unkelbach & Ben Heijmen

Motivation:

Among the three radiotherapy target volume concepts - GTV, CTV, PTV - the definition of the CTV has arguably made the least progress. While GTV definition steadily improves through novel biomedical imaging techniques and the PTV shrinks through image guidance, CTV definition is often considered the weakest element in modern precision radiotherapy. By definition, the CTV is not visible as a macroscopic tumor mass on imaging. Instead, CTV delineation is based on the anatomically defined patterns of tumor progression. Within the medical physics community, the CTV is mostly considered the domain of radiation oncologists and has attracted relatively little research attention. However, medical physics can make substantial contributions by developing computational methods to support CTV definition and the use of the CTV in planning. Examples are

- Medical image computing algorithms to automate CTV delineation and consistently account for anatomical routes and barriers for tumor progression.
- Mathematical and statistical models of tumor progression that predict the extent of microscopic disease more accurately based on quantitative analysis of imaging, histopathology, and patterns of failure.
- Development of probabilistic optimization approaches that explicitly account for gradual microscopic infiltration and uncertainties in the extent of disease.

This being a workshop we want to encourage an active participation and interaction between the participants to foster collaboration and networking. For that reason, participants will be requested to prepare a short presentation (a pitch) to present their research in the field allowing identification of common points of interests and share experiences.

Outcome:

The goal of the workshop is to exchange work on computational methods to support CTV delineation and use of the CTV in planning and bring together medical physicists, radiation oncologists, and computer scientists working in this field.

1. Summarize current work and formation of an international network of research groups.
2. Promote and strengthen computational research on the CTV within the medical physics community.
3. Write a joint paper on the current state of computational methods for handling microscopic disease and define future research direction

Day 1	**Friday 25 October**
08:00	Registration opens
09:00-09:15	Introduction of the meeting: **Núria Jornet,** Overall Chair of workshop (All)
09:15-10:00	Opening lecture, All participants • Robert Jeraj - *Medical physics got stuck in a box - how to get out*
10:00-10:30	Coffee
10:30-12:30	**Introduction: Jan Unkelbach** • Conceptual differences between GTV definition (segmentation of a visible abnormality on imaging) versus CTV definition (invisible) • Examples of computational methods for CTV definition • Different scopes: Automation, Consistency, Improvement • Goals of the workshop **Session 1**: CTV definition for gliomas **Invited Talk: Thomas Bortfeld** "GTV-to-CTV expansion for gliomas" Discussion topics: • Participants pitches • Neuroanatomy-consistent GTV-to-CTV expansion, accounting for anatomical barriers, sulci and reduced grey matter infiltration, white matter fibre orientation • Autosegmentation of relevant brain anatomy
12:30-13:30	**Lunch**
13:30-15:30	Session 2: CTV definition in Head & Neck (HNSCC) **Invited Talk: Vincent Grégoire** "Current practice of CTV definition in head & neck cancer" Discussion topics: • Participants pitches • Clinical practice/guidelines on CTV definition • Statistical modeling of lymphatic progression / Which levels should be included in the CTV? • Deep learning for automated CTV delineation
15:30-16:00	Coffee
16:00-17:00	Wrap up of the different topic workshops (12 min per topic) All

Day 2	**Saturday 26 October**
08:00-10:00	Session 3: Future research directions and collaborations **Invited Talk: Esther Troost** "Open challenges in CTV definition" Discussion topics: • Participants pitches • For which other tumor sites is CTV definition challenging? • Where can medical physics contribute?

	• Which methodologies discussed for gliomas and Head&Neck can be transferred to other sites?
10:00-10:30	Coffee
10:30-12:30	**Session 4: Beyond binary CTVs** Discussion topics: • Participants pitches • Target volumes are uncertain and not naturally binary. E.g. the gradient of tumor cell density (gliomas), or the probability of microscopic involvement (H&N), are continuous. • How can this be accounted for in treatment planning?
12:30-13:30	**Lunch/commercial symposia**
13:30-14:30	Discussion on next steps; take home messages; identify open issues for further research
14:30-15:30	Wrap up: highlights of the different workshops (12 min per topic) All
15:30-15:45	Closure