

# Inter-fractional Motion is Not a Predictor of Delivery Accuracy in Liver Stereotactic Body Radiation Therapy

Physics and Astronomy Department, Radiation Oncology Physics Department, University of Calgary, Alberta, Canada

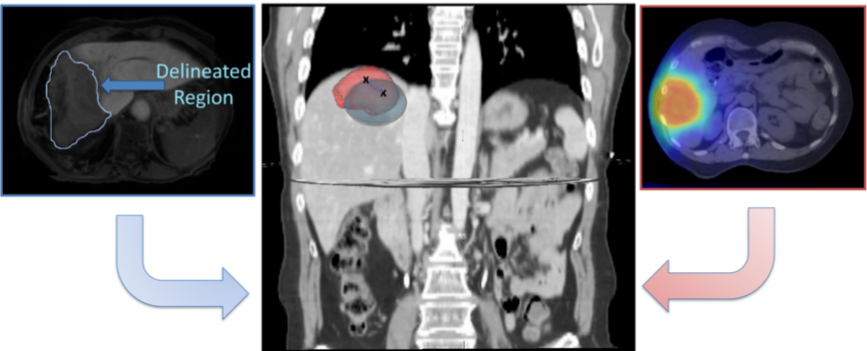
Kuznetsova S\*, Sinha R, Ploquin N, Thind K



## Introduction

- Liver SBRT is characterized by high biological effective dose and steep dose gradient. Therefore, assessment of delivery accuracy is paramount.
- Inter-fractional motion is an indirect and commonly used approach in the treatment margin quantification.
- The direct assessment of inter-fractional motion's approximation of liver SBRT delivery accuracy has not been previously conducted.
- **Purpose:** To measure the influence of Inter-fractional motion on geometric delivery accuracy in liver Stereotactic Body Radiation Therapy (SBRT) using advanced MRI technique.

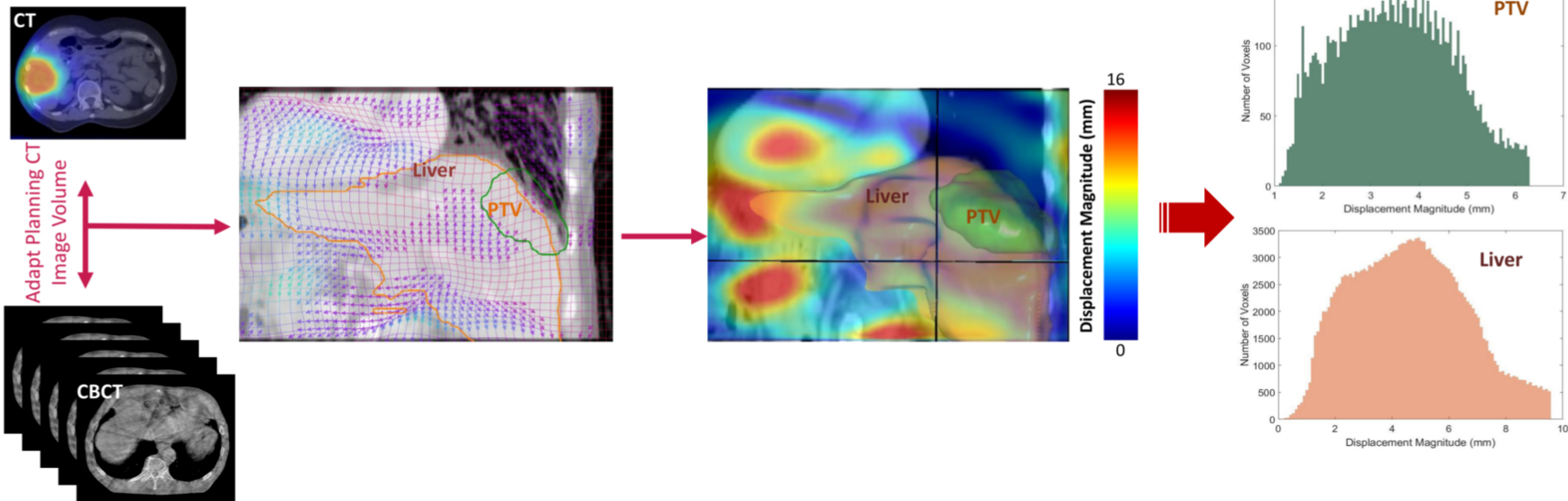
## Materials and Methods: Direct Evaluation of Delivery Accuracy



**Part I:** Primovist® - MRI scans following liver SBRT allow for direct visualization of radiation dose deposition in the form of hypo-intensity. We developed a framework for processing of these MRI scans and then quantified the geometric centre of mass shift between auto-segmented hypo-intensity and original target as defined on pre-treatment planning CT; the application of this approach was performed on 15 liver SBRT patients.

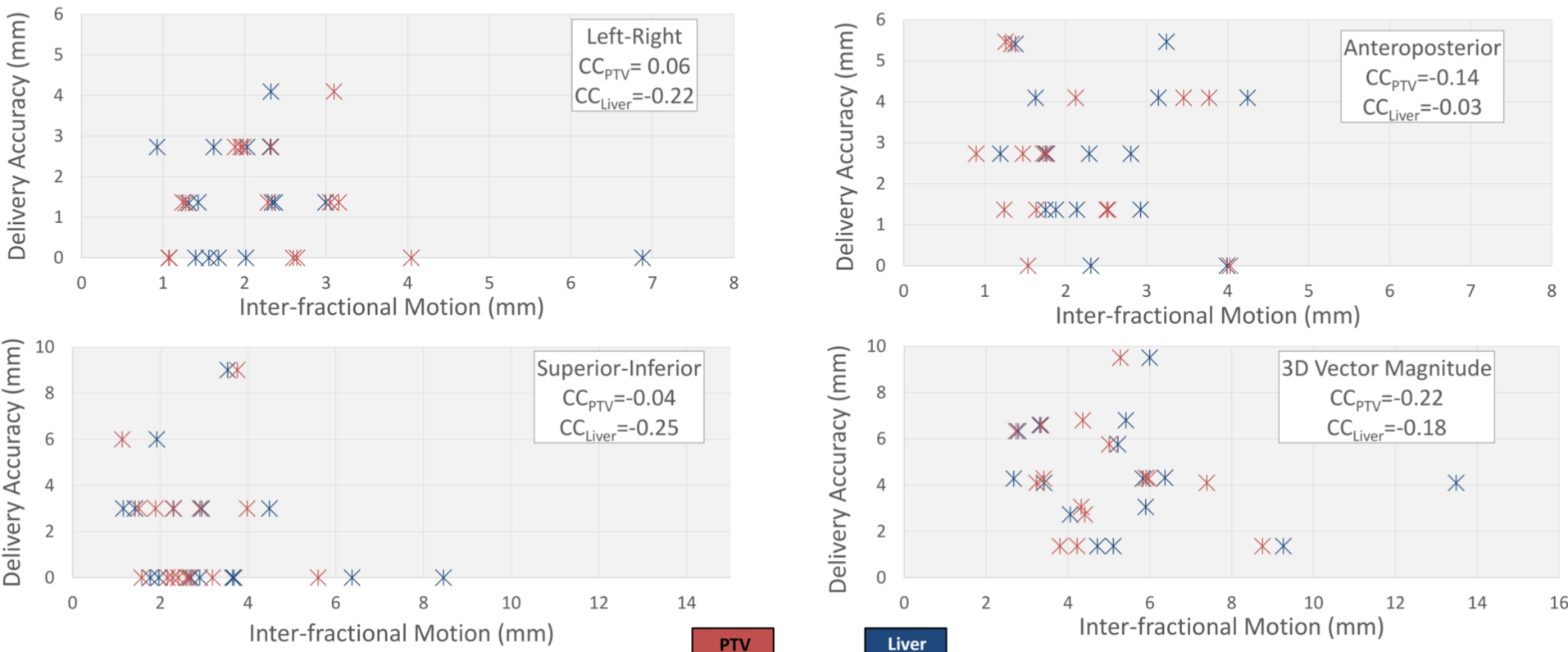
## Materials and Methods: Inter-fractional Motion Assessment

**Part II:** The inter-fractional motion was evaluated for the same 15 patient cohort using Cone Beam CT (CBCT) obtained at each fraction. Each CBCT was registered to the pre-treatment simulation CT to calculate the voxel-based shifts of the liver structure, which were averaged over all of the simulation CT-CBCT pairs.



**Part III:** The inter-fractional motion (averaged CT-CBCT pairs) were compared against the directly evaluated delivery accuracy (CT-MRI pair) in three directions: left-right, anteroposterior and inferior-superior.

## Results: Correlation Between Inter-fractional Motion and Delivery Accuracy



	Left-right	anteroposterior	inferior-superior	3D Vector Magnitude
Delivery Accuracy (mm)	1.5 (1.3)	2.6 (1.7)	2 (2.7)	4.4 (2.3)
Inter-fractional Motion				
PTV (mm)	2.2 (0.9)	2.1 (1)	2.7 (1.1)	4.8 (1.7)
Liver (mm)	2.2 (1.4)	2.4 (0.9)	3.3 (2)	5.6 (2.8)

Table: Delivery accuracy results evaluated using post-SBRT MRI, and Inter-fractional motion results for the PTV and Liver structures.

## Discussion & Conclusion

- This study was able to quantify the delivery accuracy of liver SBRT using a novel framework.
- This study also assessed the correlation of the quantified inter-fractional motion against delivery accuracy.
- The inter-fractional motion results showed the highest shifts of both structures in the inferior-superior direction.
- Our direct evaluation of delivery accuracy showed direction with the highest delivery accuracy deviation in the anteroposterior direction.
- All of the |CC|s were below 0.25, hence suggesting a lack of correlation between inter-fractional motion and actual delivery accuracy, which is counterintuitive to previous understanding.

Svetlana Kuznetsova  
Email: [skuznets@ucalgary.ca](mailto:skuznets@ucalgary.ca)  
University of Calgary  
Alberta, Canada

