To What Extent Can High Frequency Non-invasive Ventilation Reduce Breathing Motion for Liver Stereotactic Ablative Radiotherapy?

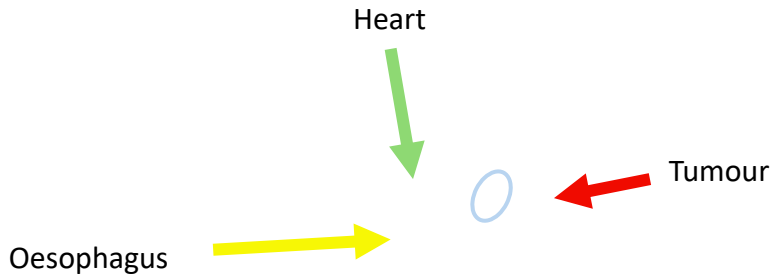
Preliminary findings

Tabi Cox

Background

Motion management is key

Respiratory motion reduces the quality of radiotherapy treatment plans for thoracic targets



Free Breathing

Respiratory motion management for external radiotherapy treatment

J Darréon [1], G Bouilhol [2], N Aillières [3], H Bouscayrol [4], L Simon [5], M Ayadi [6]

Background

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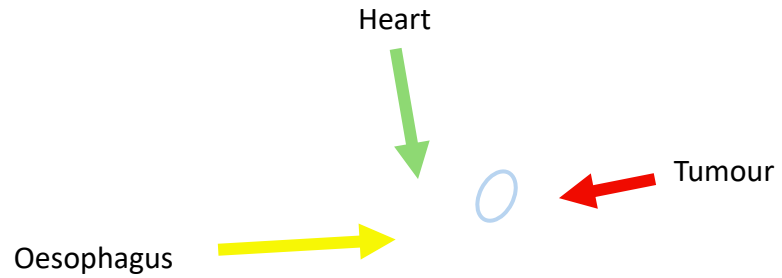
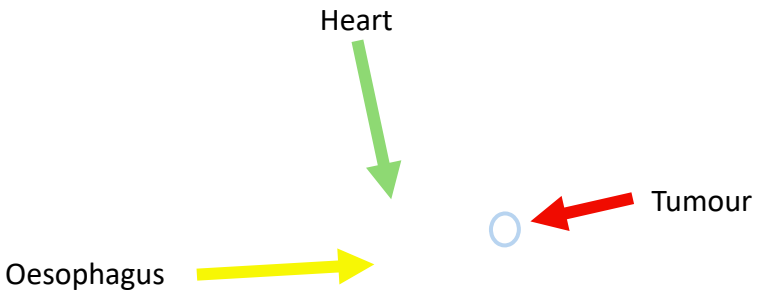
Respiratory motion reduces the quality of radiotherapy treatment plans for thoracic targets

Non-invasive ventilation (NIV) is a promising active management strategy



Free Breathing



NIMV Fast Breathing

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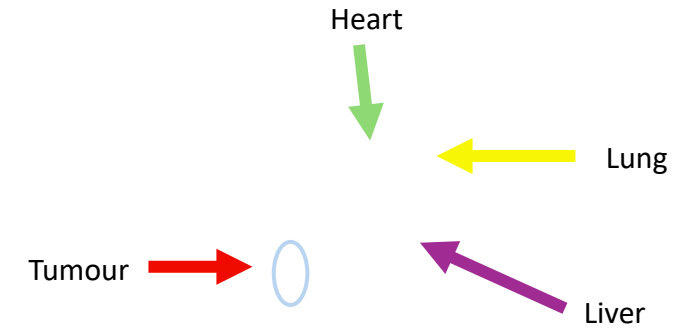

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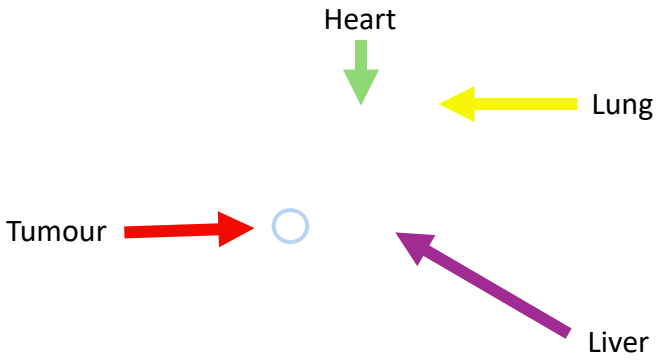

NIV Fast Breathing

Literature has demonstrated efficacy of NIV for liver but has focused on NIV-assisted breath holds.

Aim: To what extent can high-frequency NIV reduce breathing motion for liver SABR?

Acronym Library

NIV: Non-invasive ventilation
SABR: Stereotactic ablative radiotherapy

Methods

Healthy participant study

Acclimatisation Session in clinic room

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MRI Scan

6 healthy volunteers recruited (so far)

Methods

Healthy participant study

Acclimatisation Session in clinic room

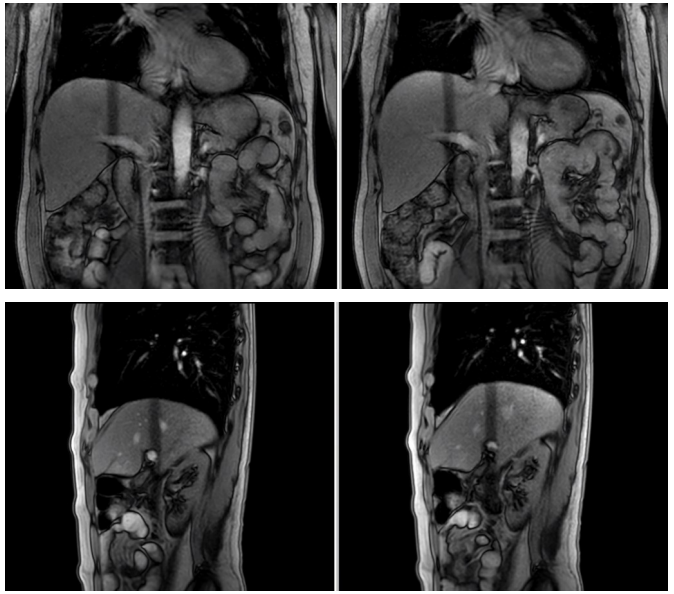
MRI Scan

5min Free breathing

5min 35brpm 0 PEEP

5min 45brpm 0 PEEP

6 healthy volunteers recruited (so far)



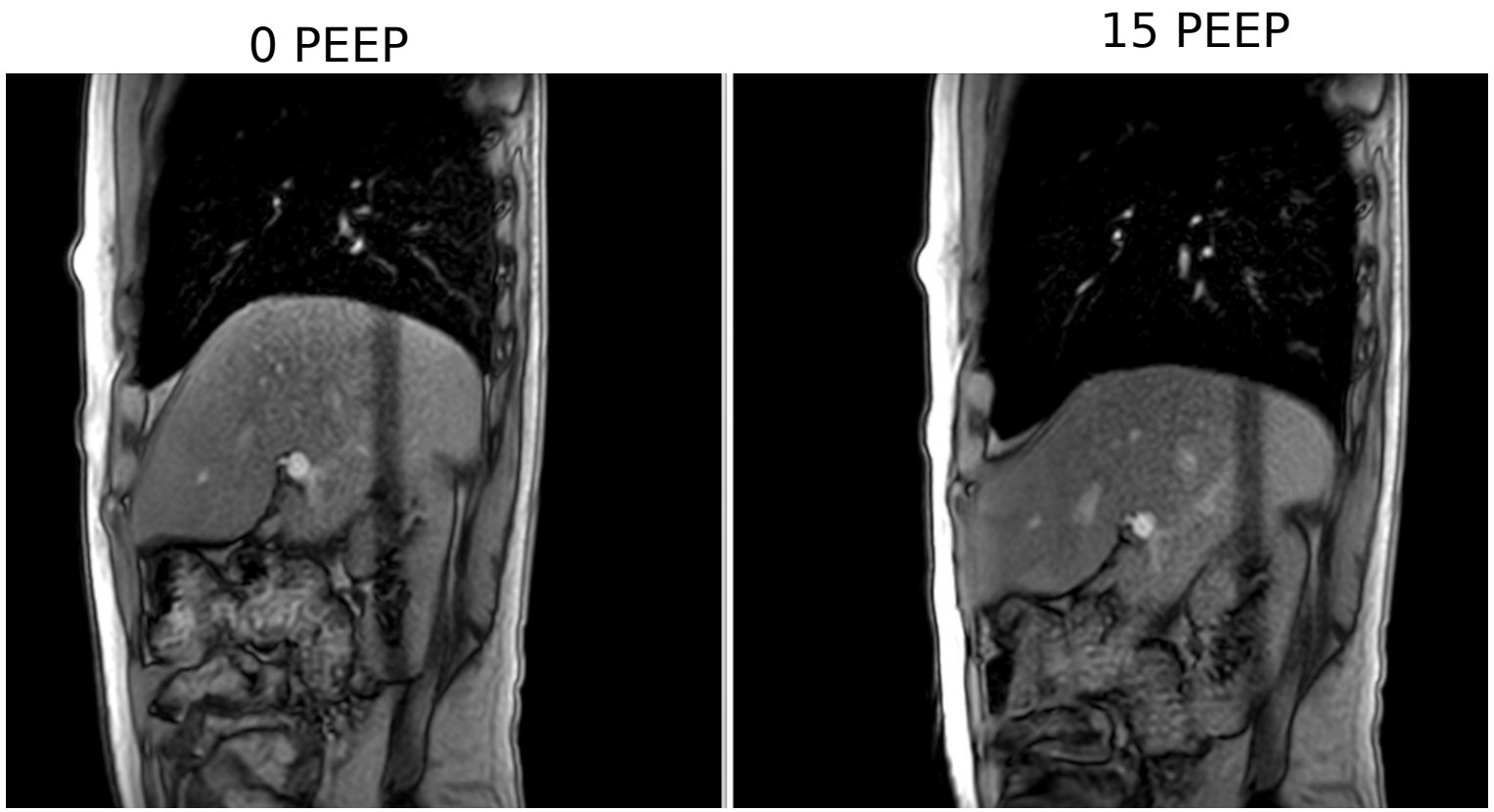
What is PEEP?

Positive End Expiratory pressure

Positive pressure applied across the entire breathing cycle

Methods

Healthy participant study



What is PEEP?

Positive End Expiratory pressure

Positive pressure applied across the entire breathing cycle

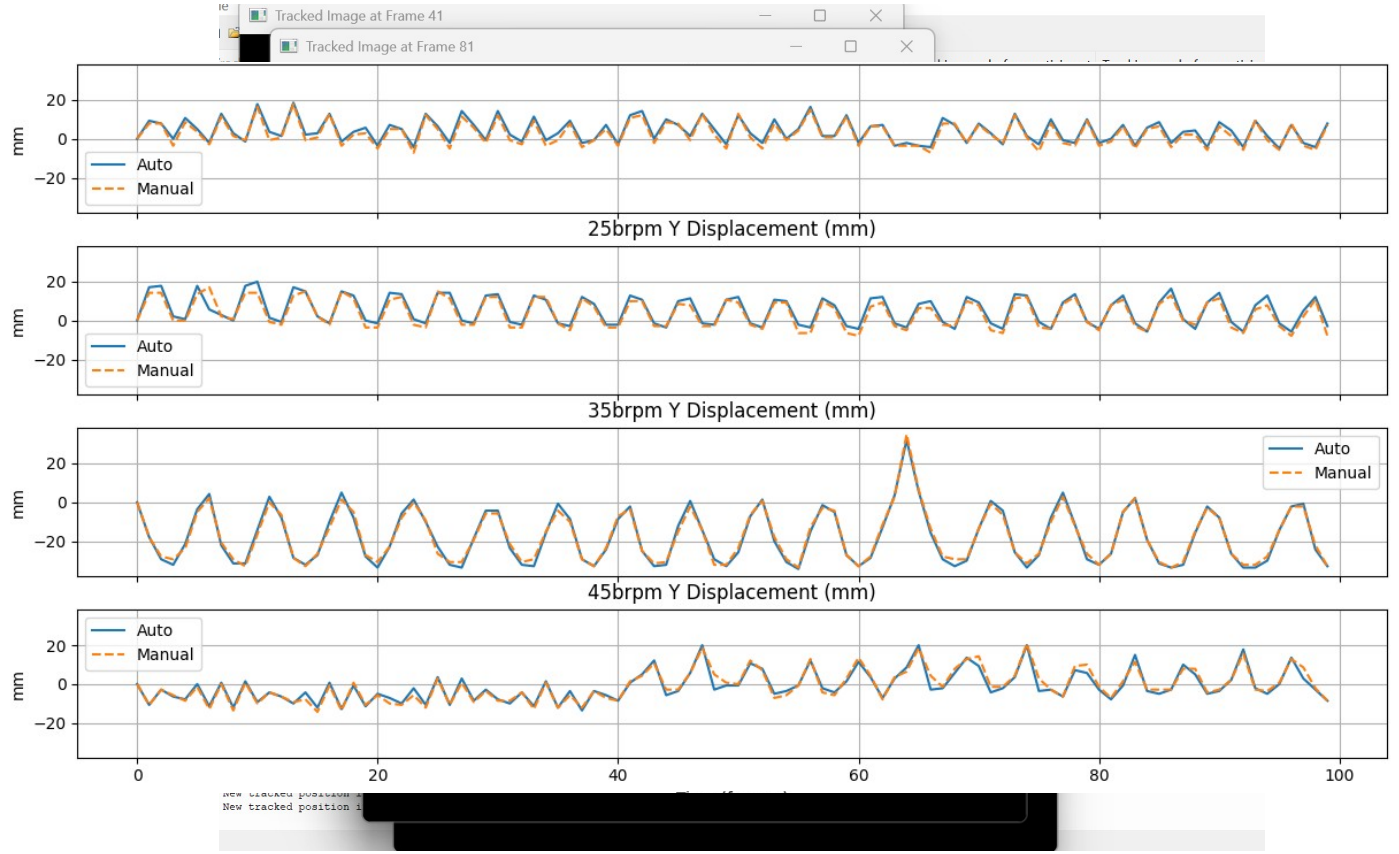
Methods

Data analysis

Images centred over the portal vein in the liver to facilitate tracking.

Portal vein tracked via an in-house python code which utilises OpenCV's template matching. Peak and trough detection enables calculation of the max amplitude.

The analysis script was validated against manual inputs for 100 frames



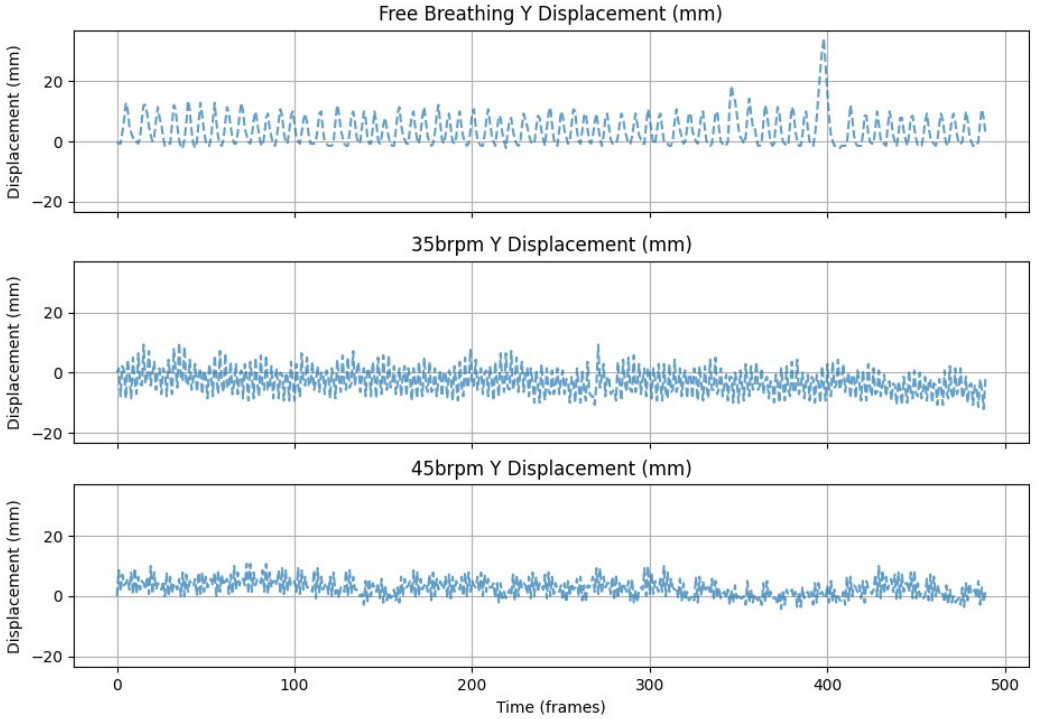
Results

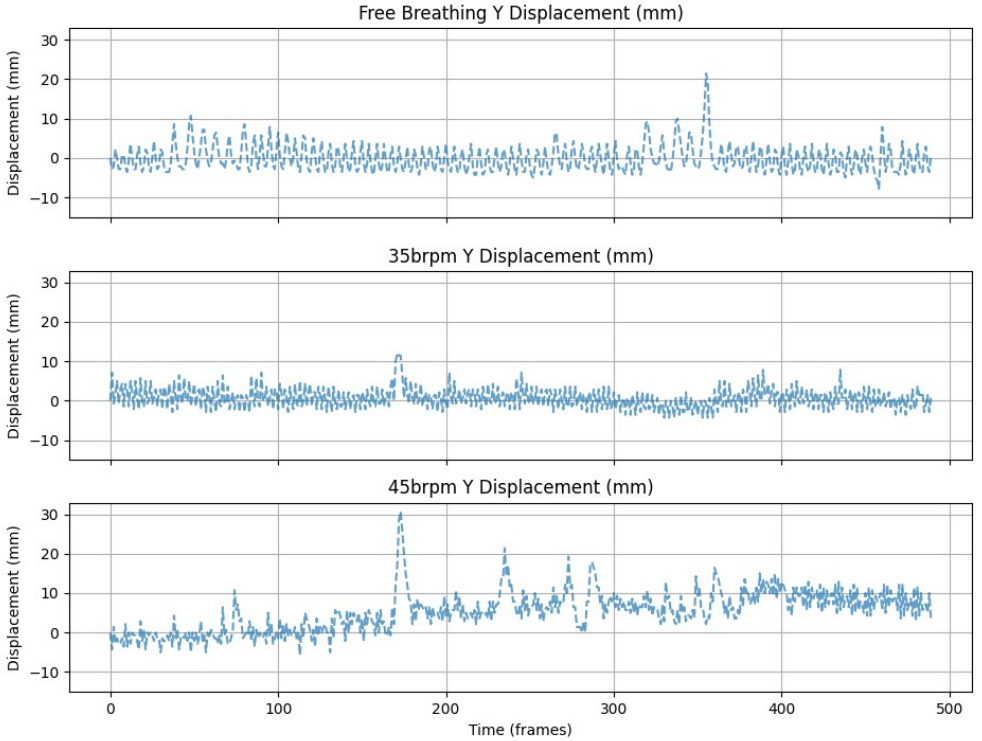
All 6 patients tolerated 5 minutes of both frequencies (35,45brpm)

1 participant struggled to synchronise to ventilator for all frequencies
1 participant struggled to synchronise to 45brpm

What is ‘synchronised’?

Participant has accepted ventilation and has a synchronised breathing trace.





Results

Mean amplitude reduction for 45brpm across fully synchronised participants was 37%

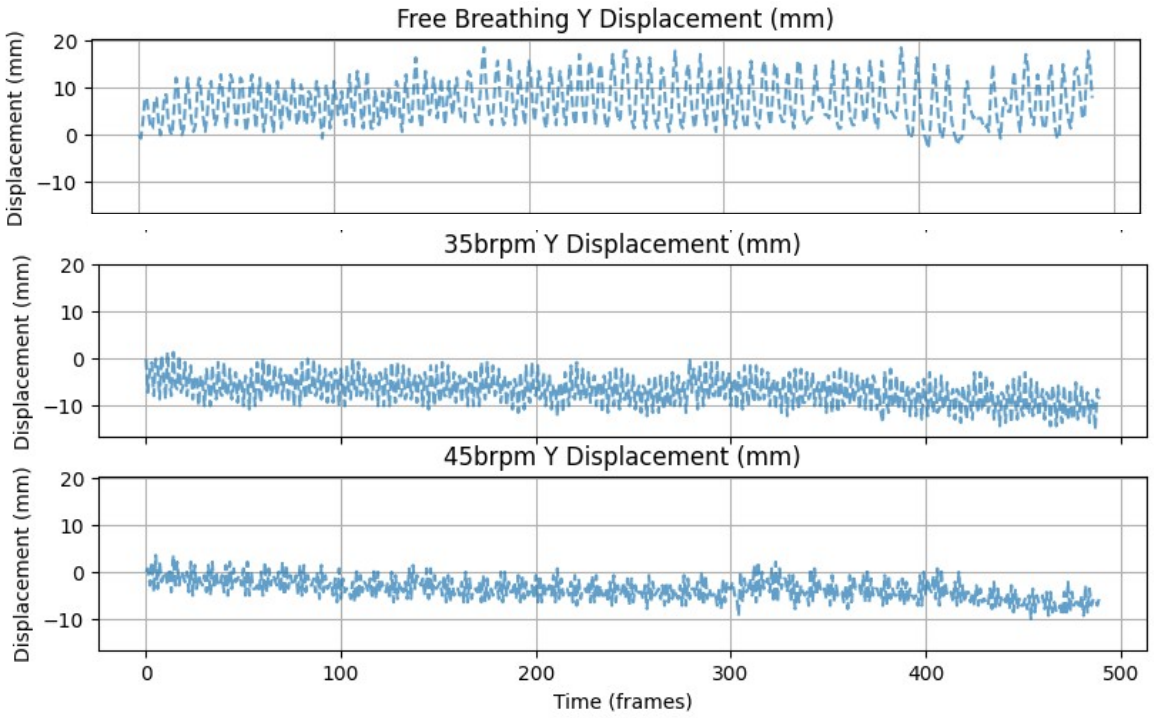
For 1 participant 35brpm reduced max amplitude from free breathing baseline by 44%

Lack in synchronicity with the ventilator at 45brpm resulted in a 24% increase in max amplitude from baseline.

Preliminary conclusion:

- High frequency NIV **can** be used to minimise breathing motion
- These benefits are maximised when participants are comfortably synchronised with ventilator.
- Demonstrates the possible benefit of a more bespoke approach towards implementation

Any Questions?



Free

b

45brpm 0 PEEP