SPEED PROFILES IN WHEELCHAIR COURT SPORTS; COMPARISON OF TWO METHODS FOR MEASURING WHEELCHAIR MOBILITY PERFORMANCE

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Wheelchair court team sports

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Wheelchair court team sports

- Rugby (Quad rugby)
- Tennis
- Basketball
- Hockey

- Field position
- Wheelchair mobility performance
  - Wheelchair kinematics

Speed & rotations

- Able bodied sports
  - Speed zones: maintain speed → “power in”
  - Rotations partly within the body (trunk)
- Wheelchair sports
  - Maintain speed → “cruising”
    - Changes in speed more important (acceleration)
  - Limited rotation within body → wheelchair rotations
    - Rotations (of the wheelchair) more important

Indoor Tracking System (ITS)

- Ultra wide band technology
  - Ubisense
  - Catapult
- System
  - 4-6 sensors fixed around the court
  - Single tag on each player (wheelchair)
  - Frequency bandwidth shared (~6Hz)
- Outcomes
  - Position (on the field), heatmaps
  - Speed & displacement

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The validity and reliability of a novel indoor player tracking system for use within wheelchair court sports

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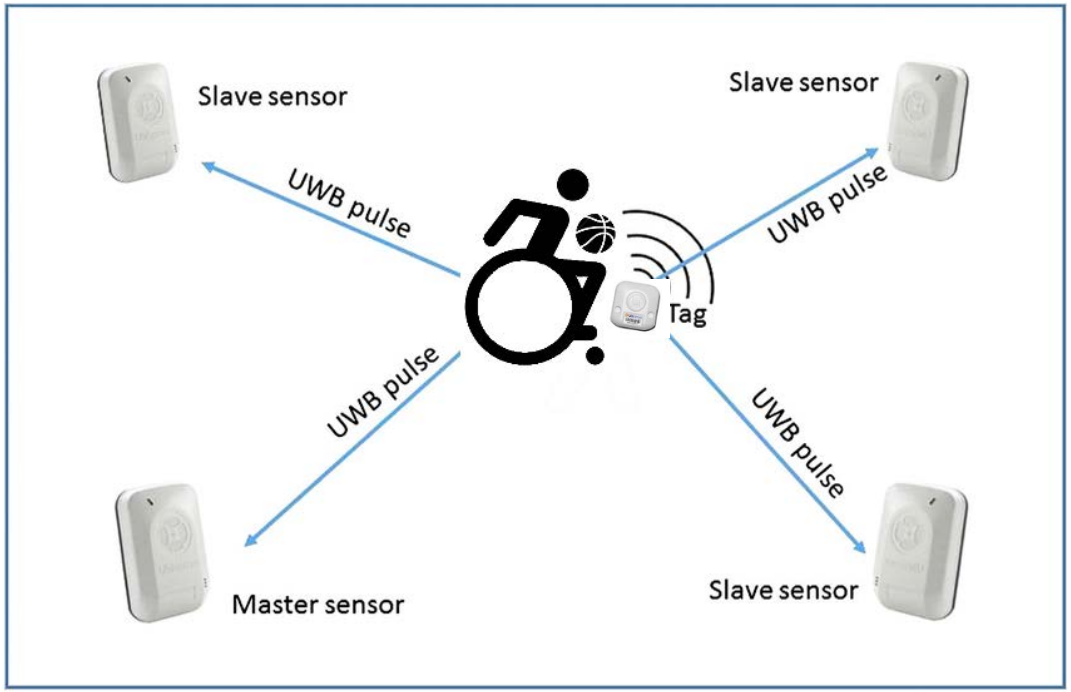

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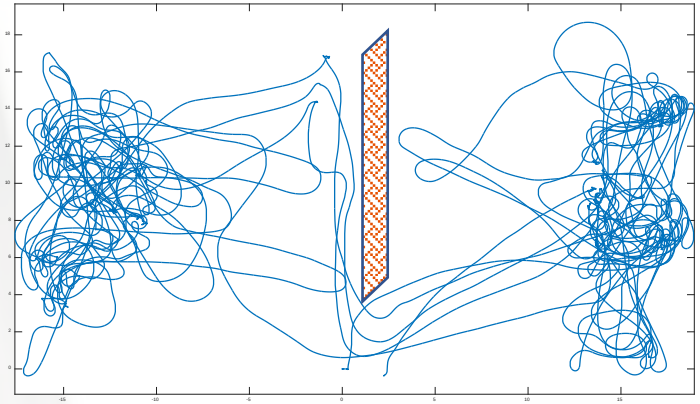
Wheelchair Mobility Performance Monitor (WMPM)

- Inertial sensors
  - Wheels & frame
  - No global reference
- Outcomes
  - Forward
    - Displacement, speed & acceleration, push characteristics
  - Rotational
    - Rotation, rotational speed & rotational acceleration



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Opportunities for measuring wheelchair kinematics in match settings; reliability of a three inertial sensor configuration

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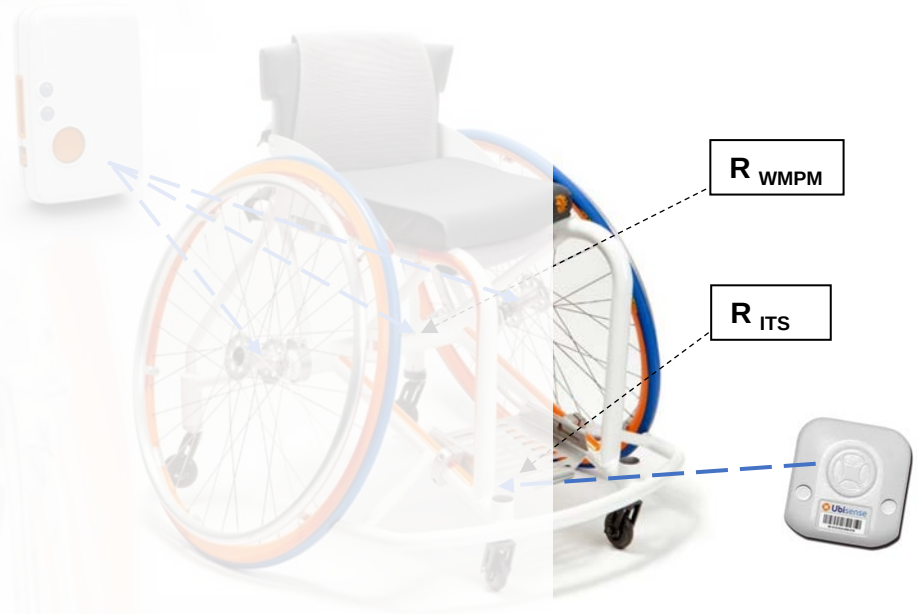
Measurements

- 6x 10 minute game measured
- 5 elite level wheelchair basketball players
- Comparison
  - Distance
  - Speed
    - Average
    - RMSE
    - Zones



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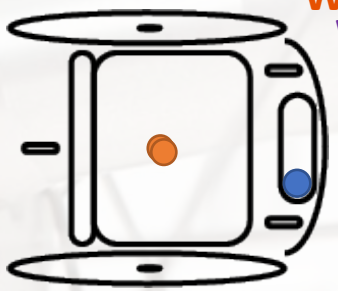
Results example plot

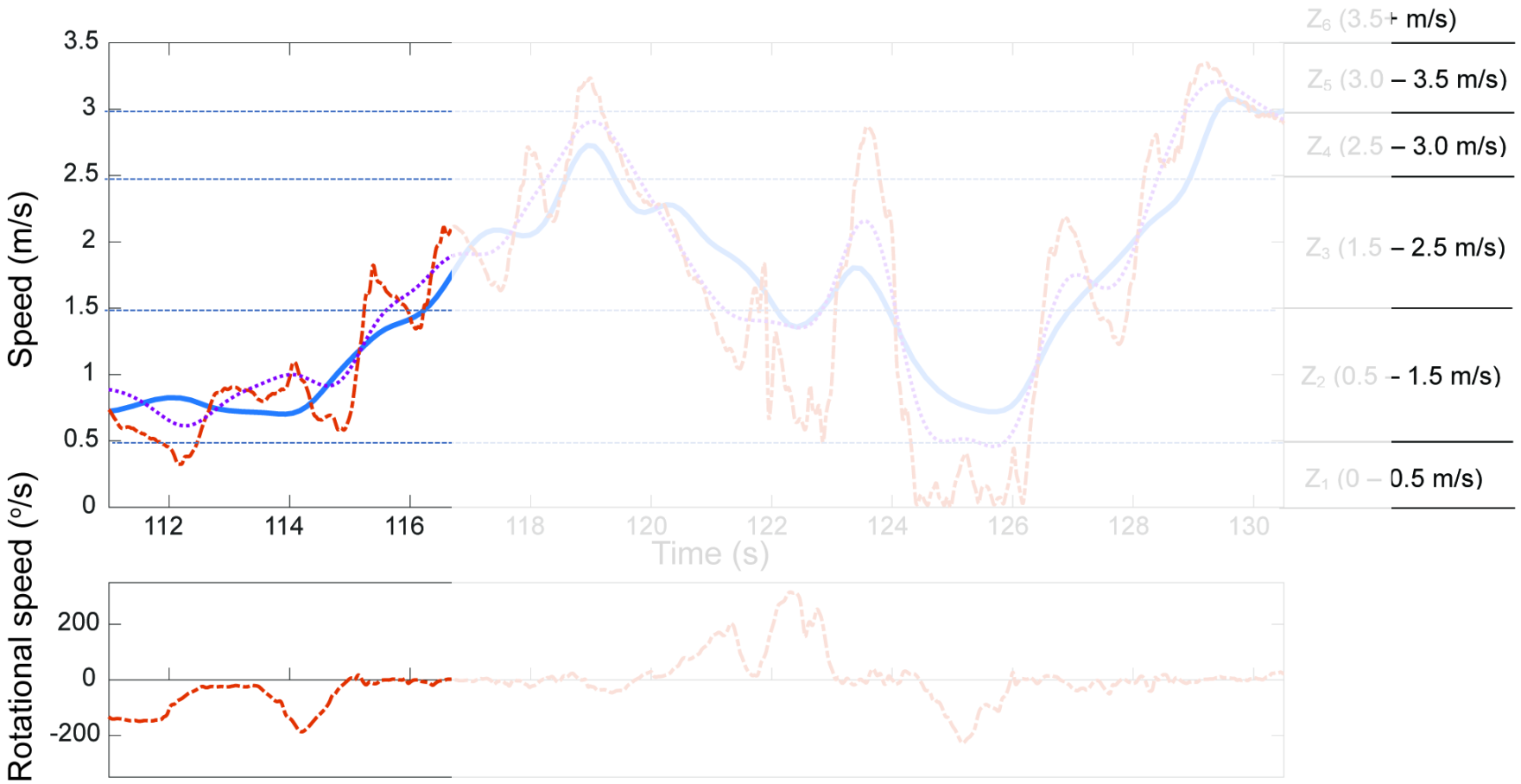
ITS

WMPM

WMPM2



WMPM
WMPM2



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Results

		Inertial sensors WMPM	*difference*	Indoor Tracking System	*difference*	Inertial sensors WMPM2
Distance per ~10 min. (m)		837.8	*-2.6% (± 3.2%)*	882.3	*0.1% (± 3.3%)*	883.4
Speed (m/s)	average	1.30	*-2.6%*	1.37	*0.1%*	1.38
	RMSE		*0.41*		*0.33*	
Speed Zone (m/s)	0 - 0.5	22.4%	*13.7*	8.7%	*5.7*	14.4%
	0.5 - 1.5	37.9%	*-15.7*	53.6%	*-9.0*	44.6%
	1.5 - 2.5	29.3%	*-0.1*	29.4%	*2.0*	31.3%
	2.5 - 3.0	6.6%	*1.0*	5.5%	*0.9*	6.4%
	3.0 - 3.5	2.8%	*0.7*	2.1%	*0.4*	2.5%
	3.5+	1.0%	*0.3*	0.7%	*0.0*	0.7%

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Conclusion

- Comparison
  - For speeds above average (1.5 m/s) similar results
  - At low speeds differences due to reference point
  - In ITS more time assigned to average speed zone due to filtering
- Future
  - Recalculate for reference point if needed
  - Combine ITS with a single IMU for best results
    - Proved feasible in the research
    - Use sensor fusion techniques

Thank you for your attention!

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