the early PLAY and DEVELOMENT LABORATORY

DENOISING RFID LOCATION RECORDINGS USING KALMAN FILTERS

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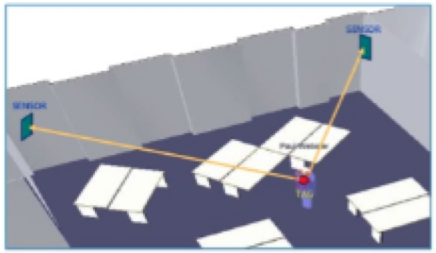
Background

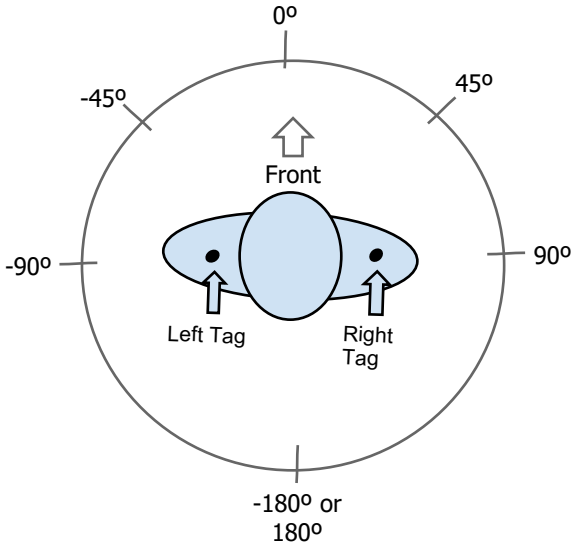
Raw Ubisense Data	Interpolation at 10 Hz	Denoising Using Kalman Filters	Denoised Ubisense Data	Further Analysis
Raw Ubisense Data provides location data of individual tags at 4 Hz with x, y, and z coordinates.	Interpolated at 10 Hz to synchronize the positions of left and right tags by taking a weighted average	Denoising angular velocity and tag distance using Kalman filters	Adjust and record new tag positions based on denoised orientations and tag distances	Recording social contacts, animating classroom motion, etc.

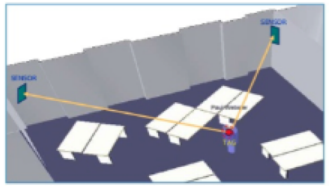


Objective and Motivation

The objective was to denoise radio frequency identification (RFID) location recordings using Kalman filters

- Recordings are used to analyze social interactions and behavior
- Small imprecisions in the location recordings
- Accurate data increases our confidence in further analyses





Cohorts

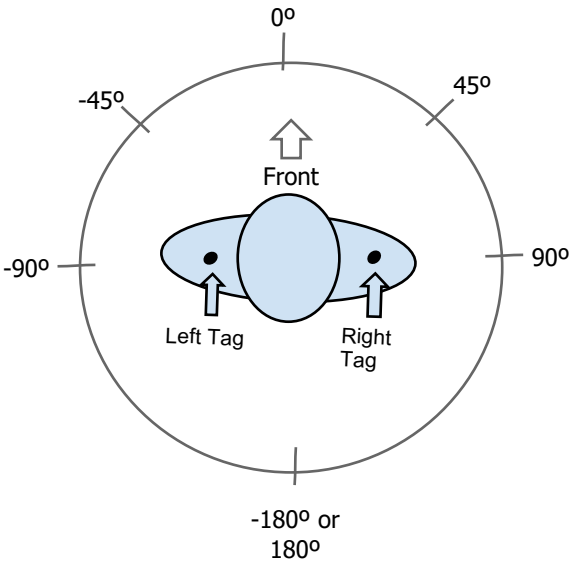
Starfish 2019-2020

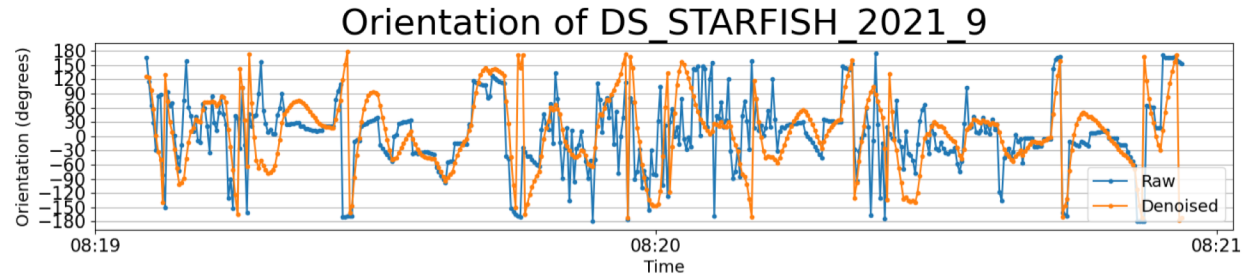
- 5 class dates
- 20 children
  - 9 children with hearing loss
  - 11 with typical hearing
- 3 teachers
- 337 hours of individual recordings

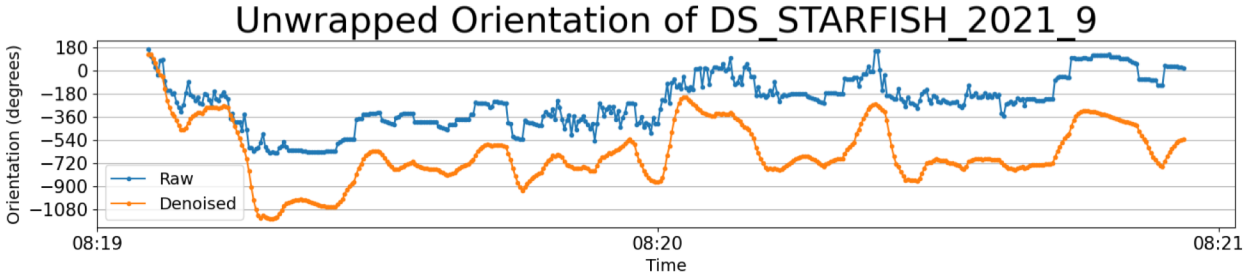
Starfish 2020-2021

- 6 class dates
- 16 children
  - 7 children with hearing loss
  - 9 with typical hearing
- 3 teachers
- 318 hours of individual recordings

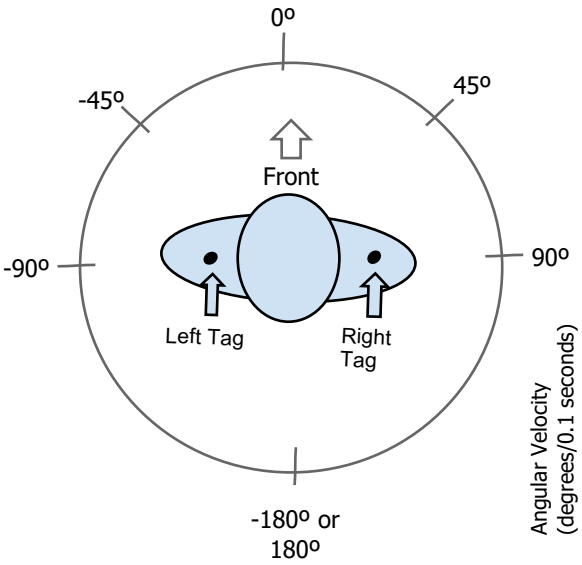
Orientation Recordings

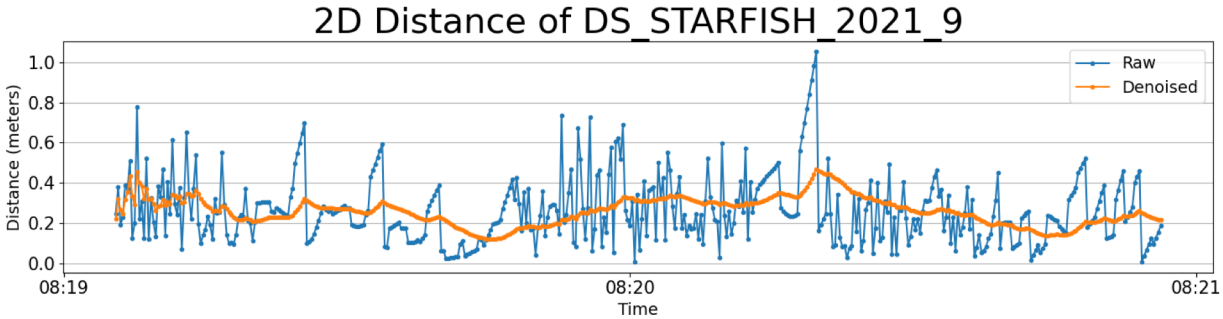


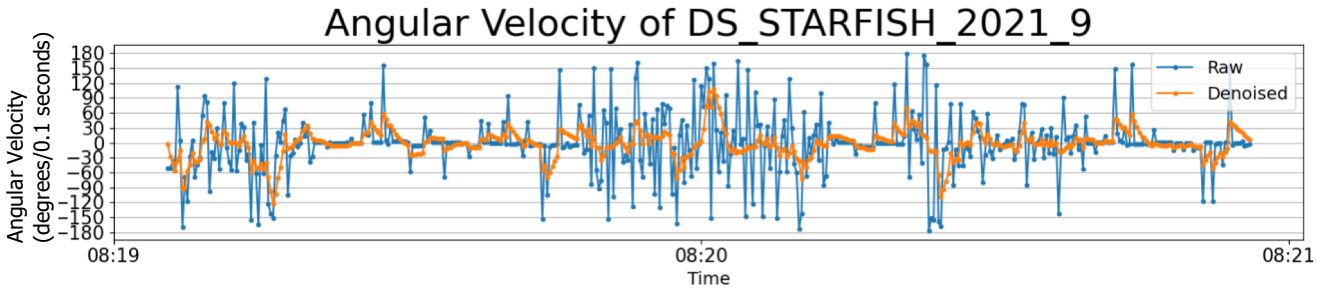




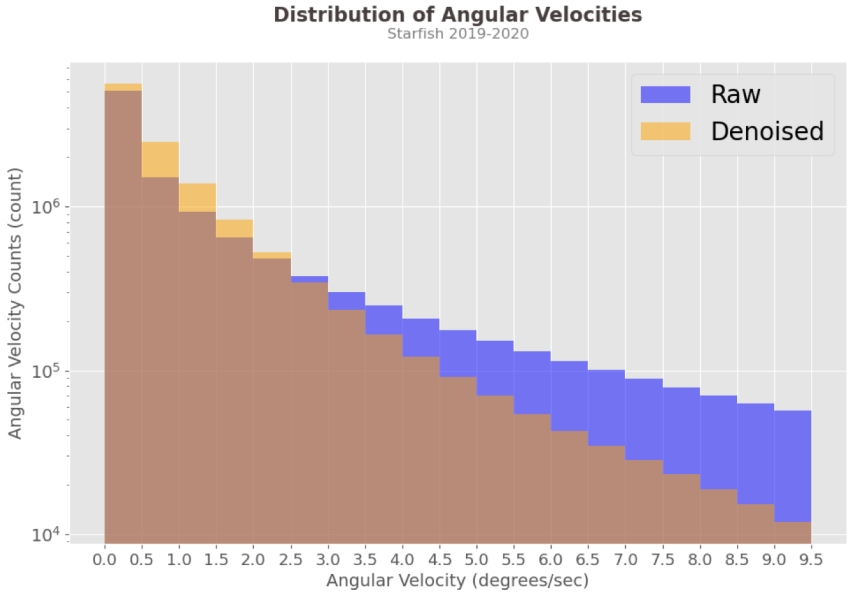
What does the denoising actually do?

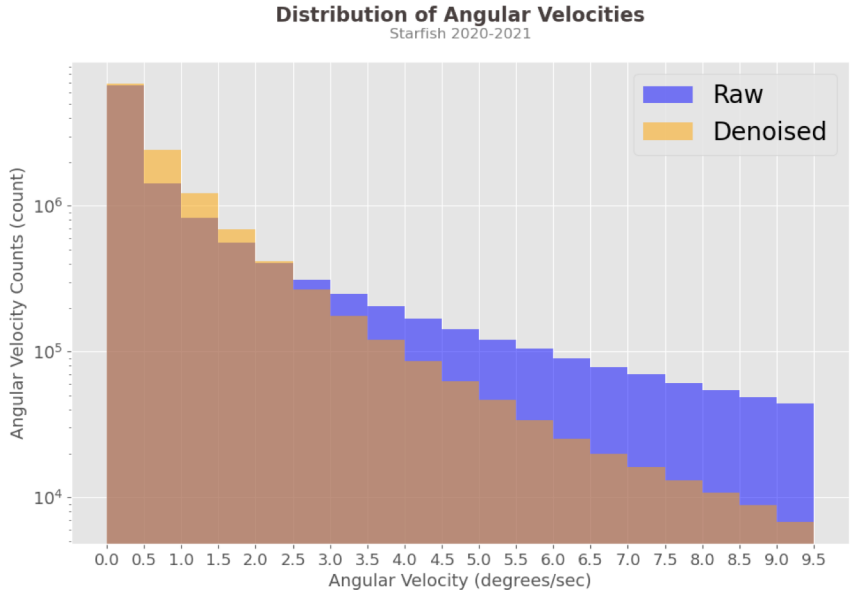






Distribution of Angular Velocity Values

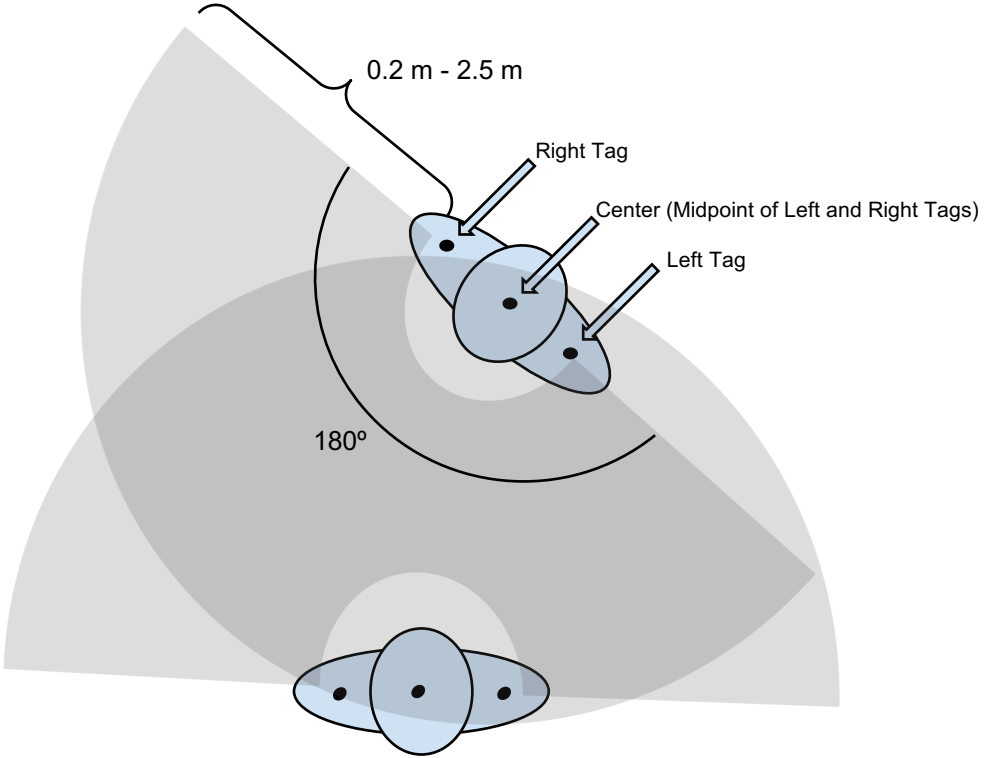




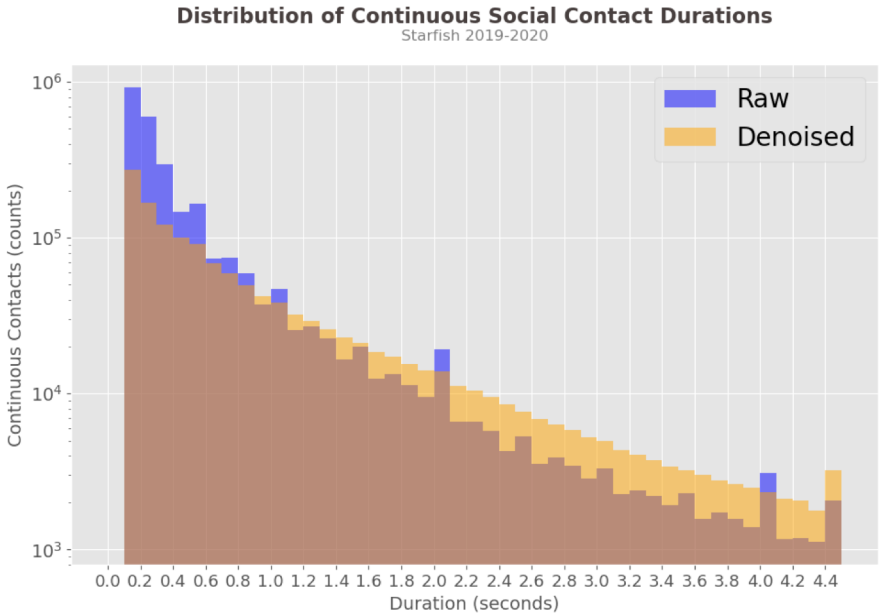
Social Contact

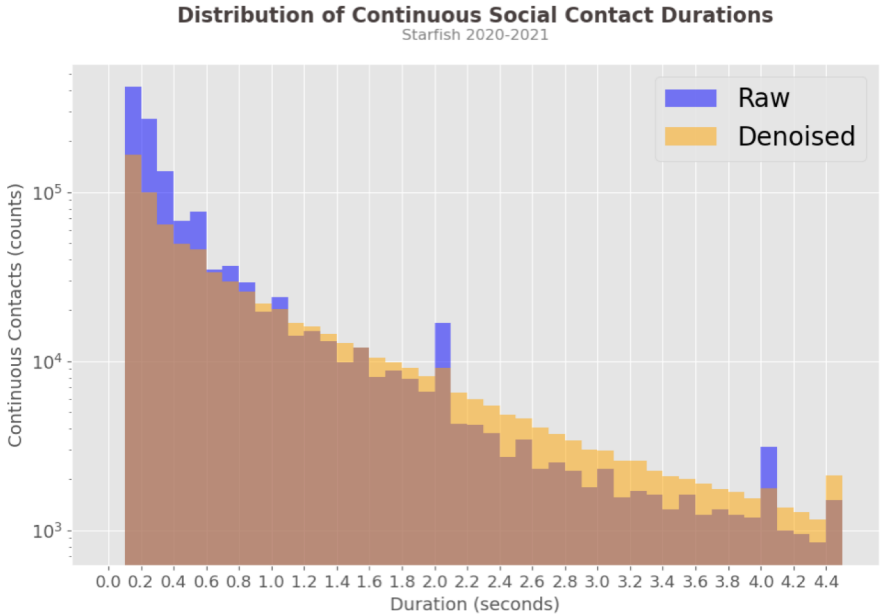
Social Contact - Instance between two subjects when their distance is between 0.2 and 2.5 meters and relative orientations of less than 90º

Continuous Social Contact - Period where social contact criteria is continuously met

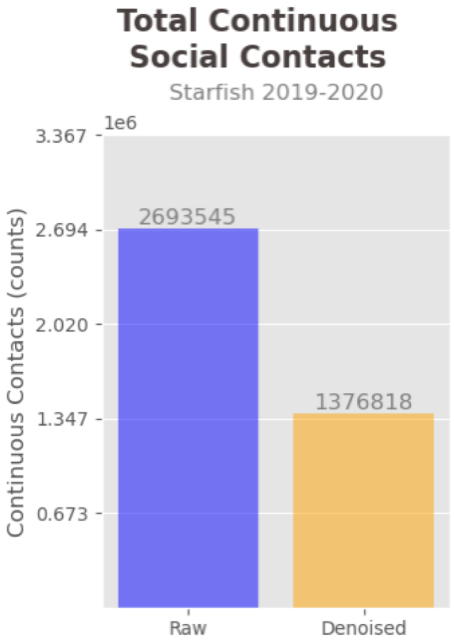


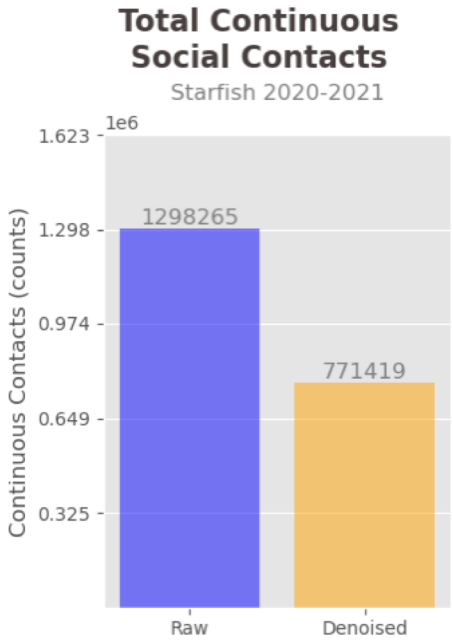
Total Distribution of Social Contact Durations



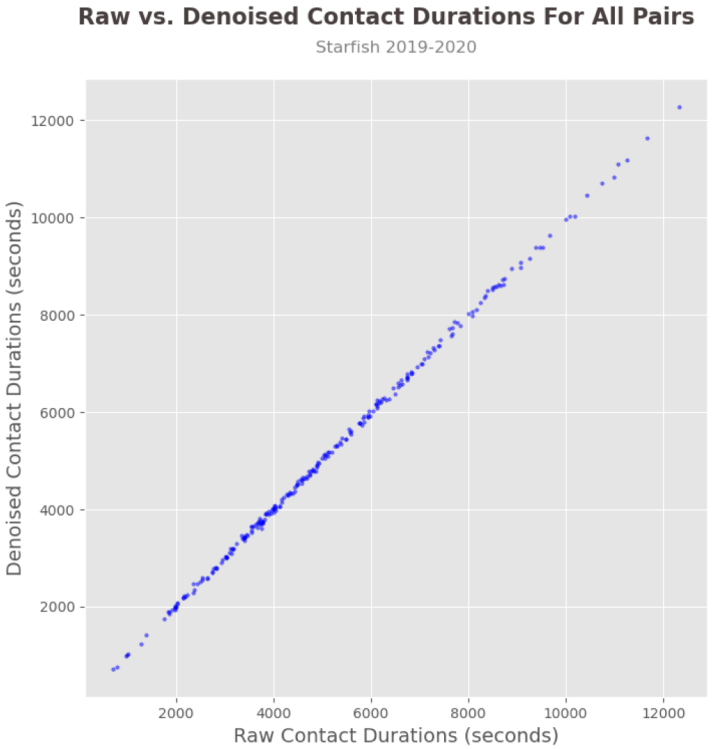


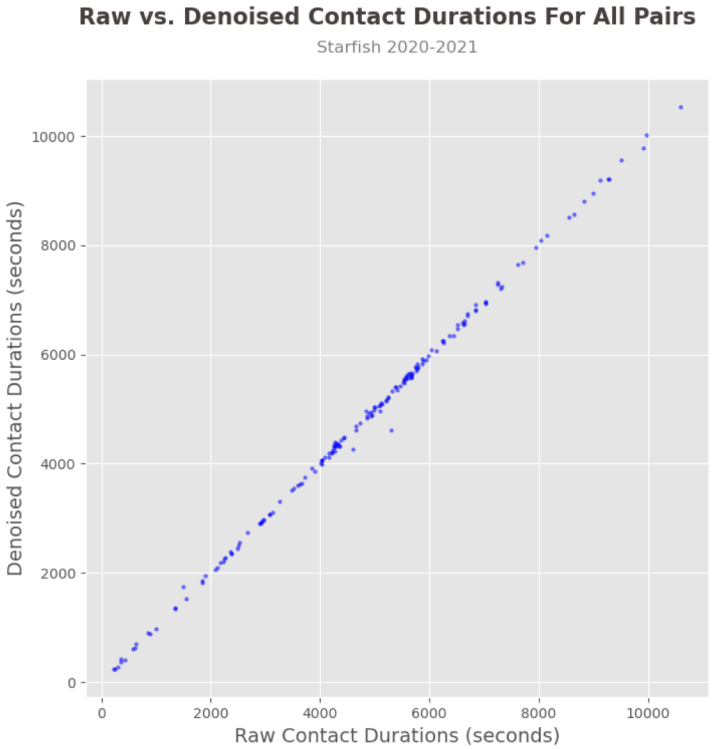
Total Continuous Contacts





Raw vs. Denoised Contact Durations





Conclusion and Impact

- The denoising produces more reliable and realistic results from Ubisense tracking data
- Improves our ability to objectively measure social interactions in the classroom and better predict typical and atypical development