Follower-Leader Concept in Microscopic Analysis of Pedestrian Movement in a Crowd

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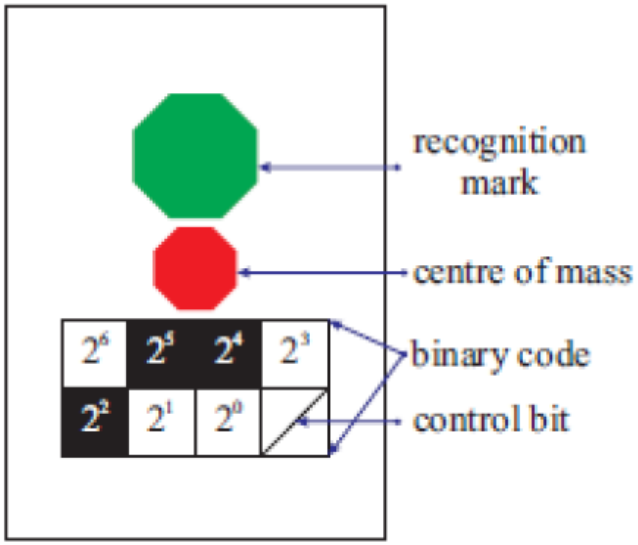
Motivation

- Experimental data

- Velocity-density dependency

- Follower-leader concept

Experimental Data



- Study hall of our faculty
- Artificial room: 7.2 m $\times$ 4.4 m
- One exit: 0.6 m wide
- Three entrances
- Three cameras
- Recognition caps
- 10 runs

Pedestrian velocity and individual density

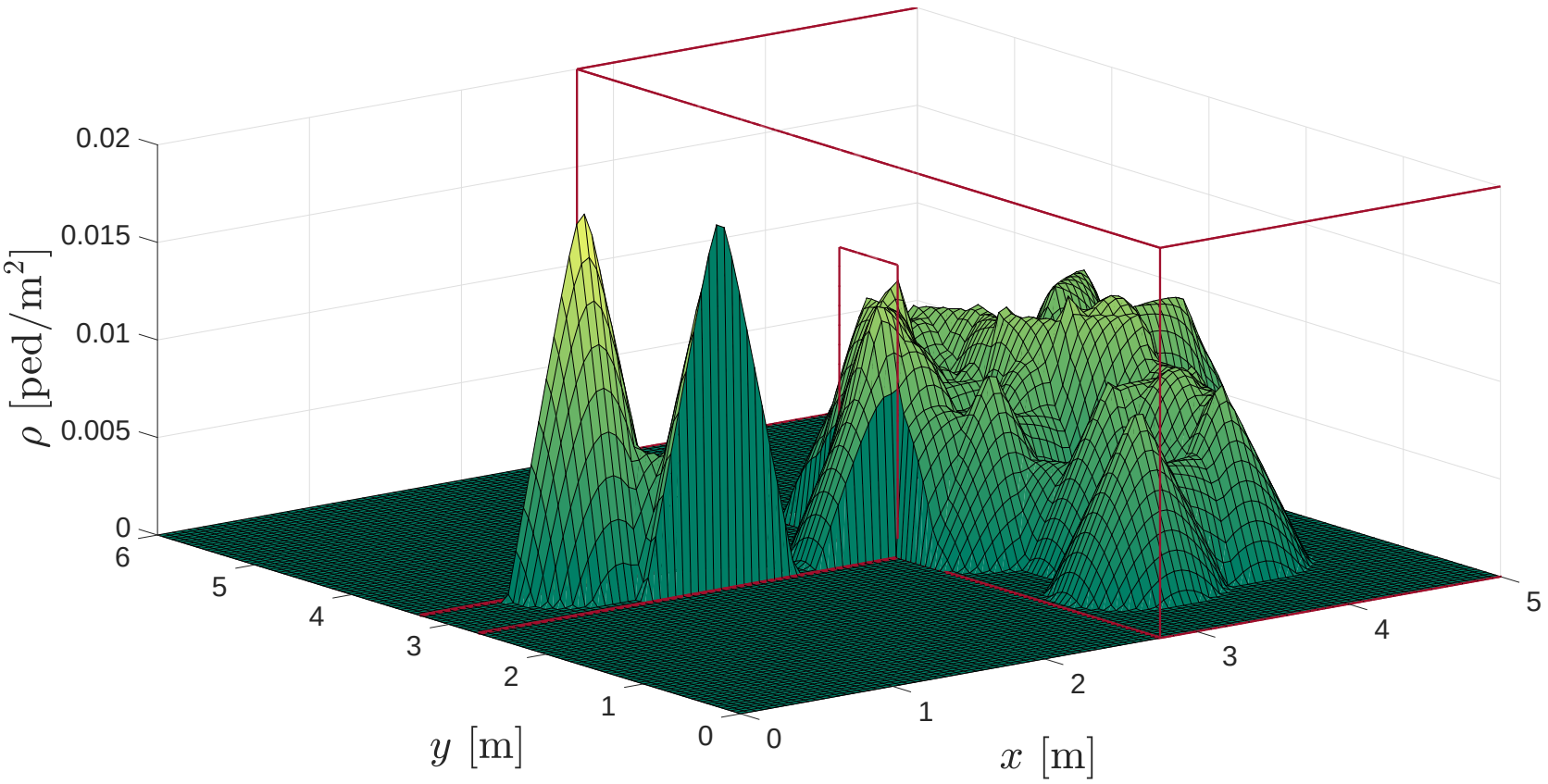
- Velocity v_α
  - Central differences of space coordinates

- Density ρ_{ω_α}
  - Individual distribution for each pedestrian $p_\alpha(\vec{x})$

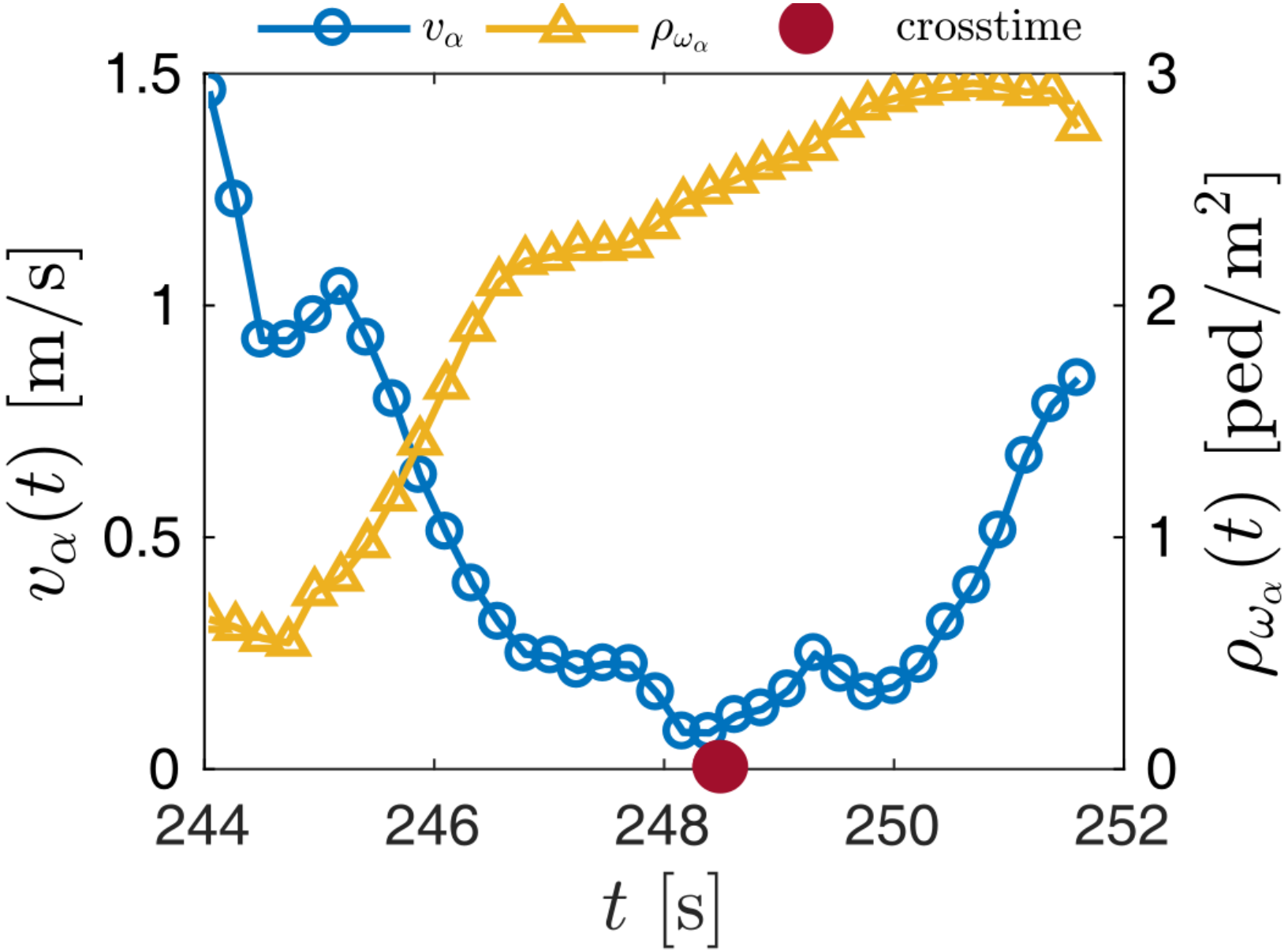
$$\rho = \frac{N}{|A|} = \frac{\int_A p(\vec{x})\,\mathrm{d}\vec{x}}{|A|} = \frac{\int_A \sum_{\alpha=1}^{N} p_\alpha(\vec{x})\,\mathrm{d}\vec{x}}{|A|} = \sum_{\alpha=1}^{N} \frac{\int_A p_\alpha(\vec{x})\,\mathrm{d}\vec{x}}{|A|}$$

  - Every single pedestrian is a source of density distribution
  - Individual density for each pedestrian ρ_{ω_α} in their surroundings ω_α

Pedestrian velocity and individual density

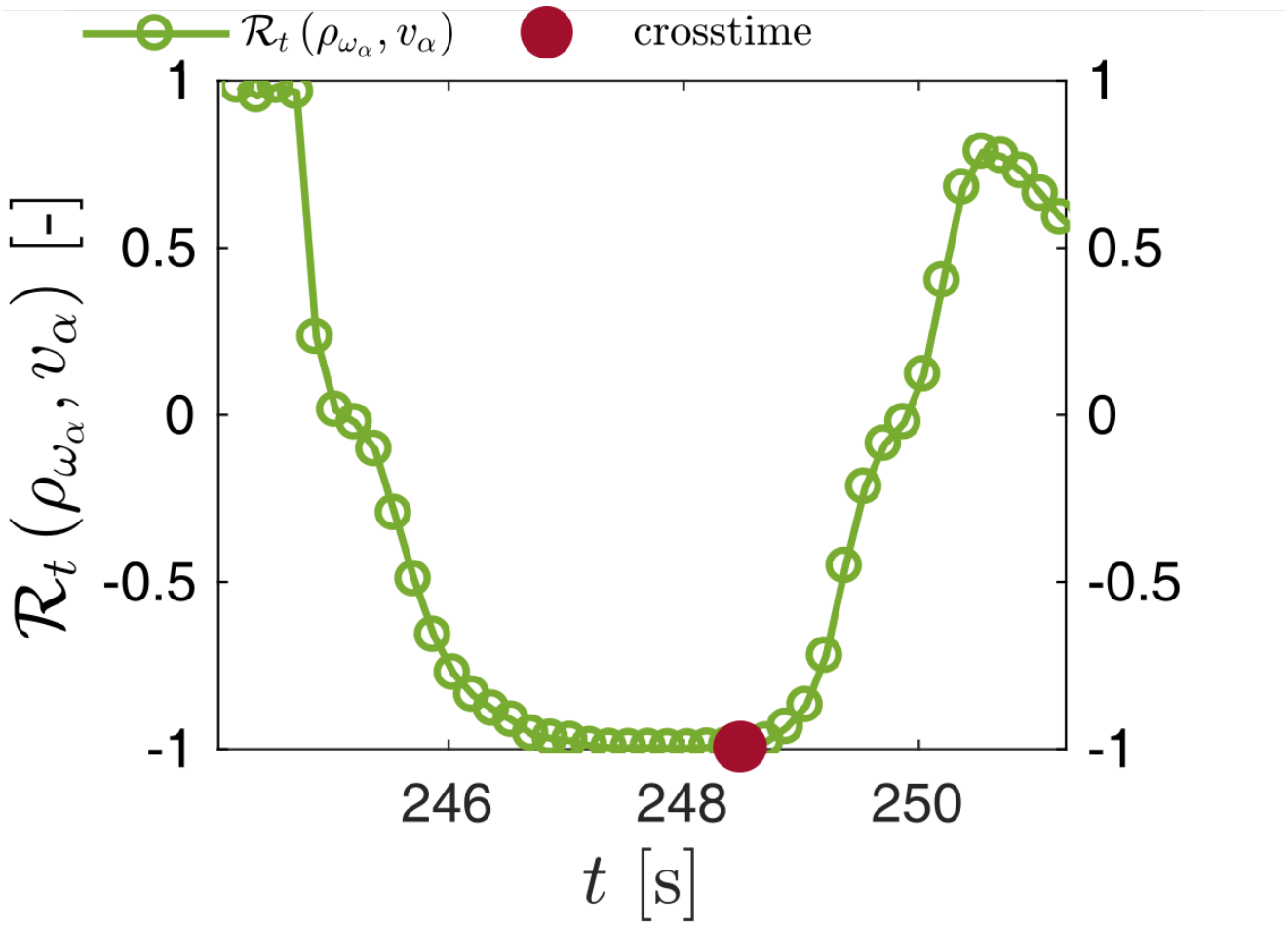


Velocity and individual density of pedestrian α



Correlation as our measure

- Reaction to pedestrian surroundings: correlation $\mathcal{R}\left(\rho_{\omega_\alpha}, v_\alpha\right)$



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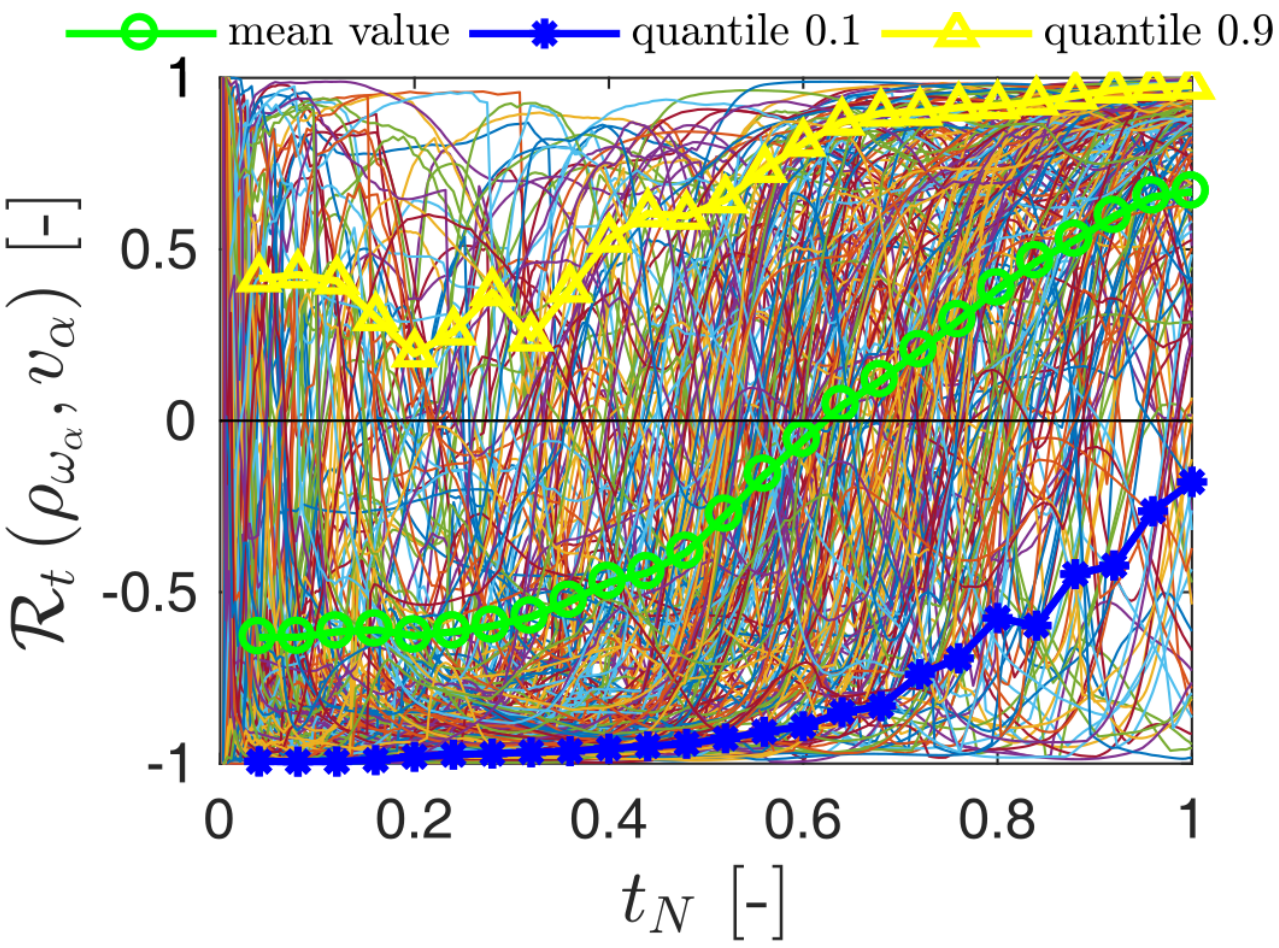

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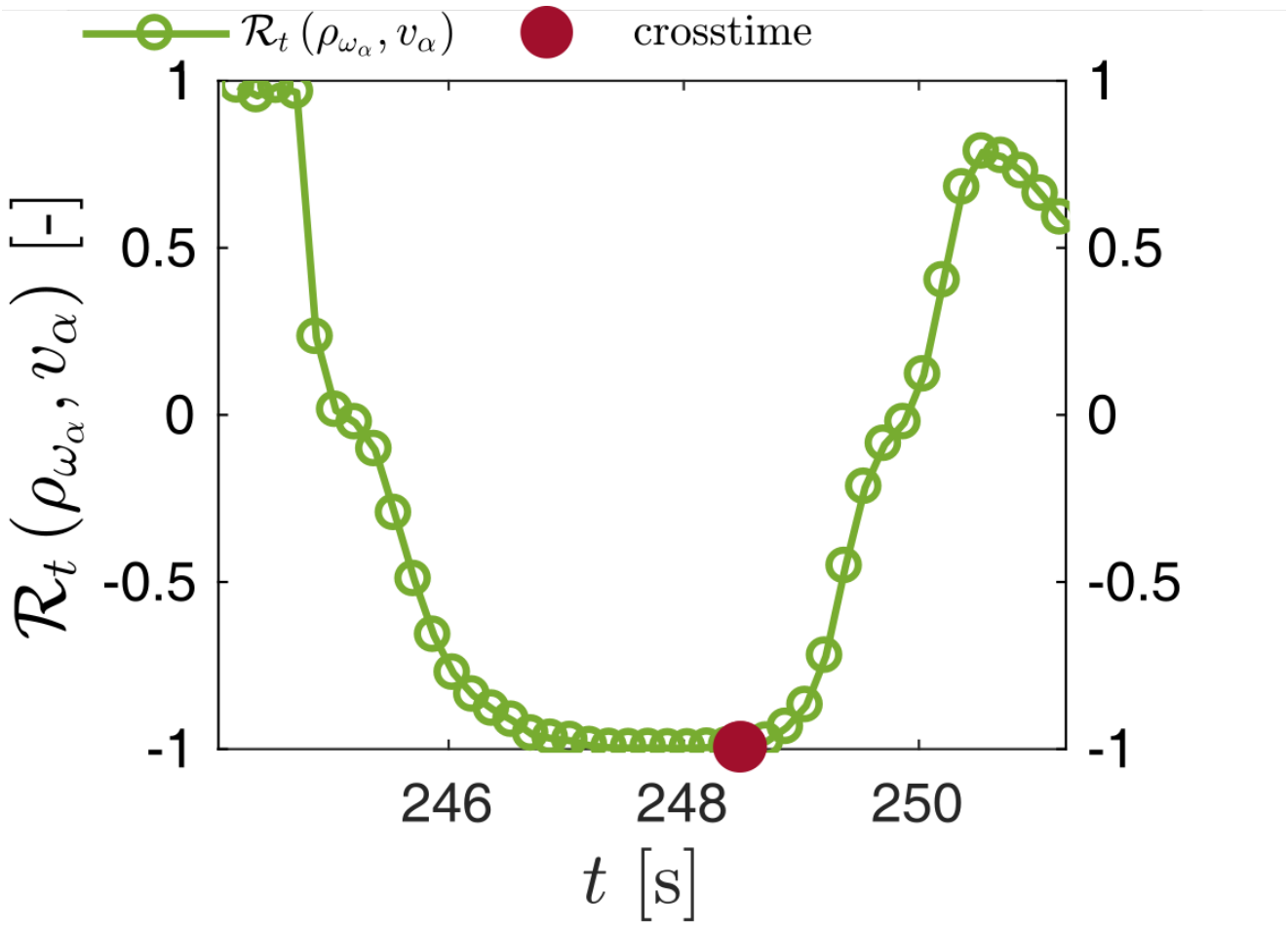
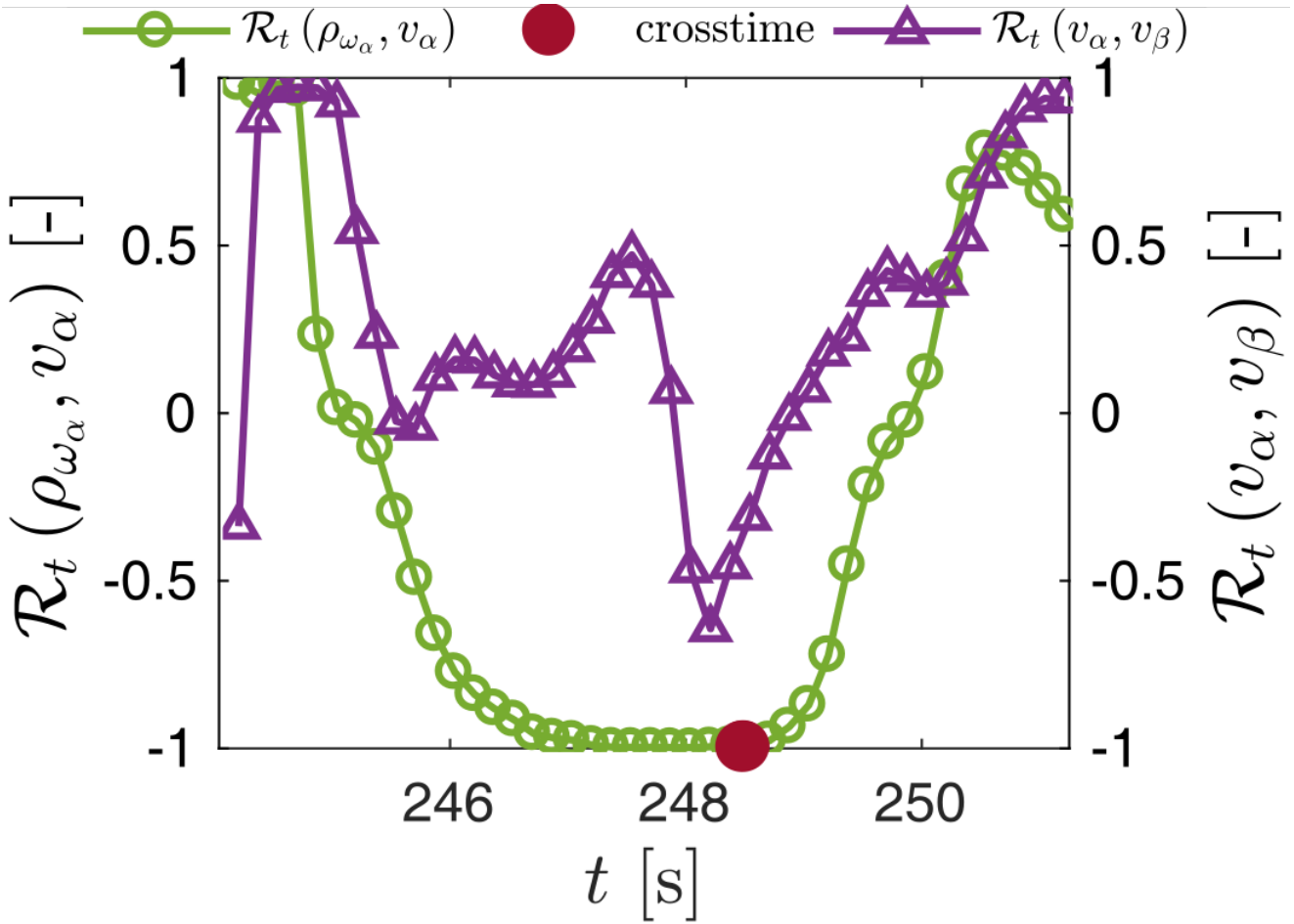


Correlation as our measure

- Reaction to pedestrian surroundings: correlation $\mathcal{R}\left(\rho_{\omega_\alpha}, v_\alpha\right)$
- Reaction to the α's nearest predecessor β: correlation $\mathcal{R}\left(v_\alpha, v_\beta\right)$



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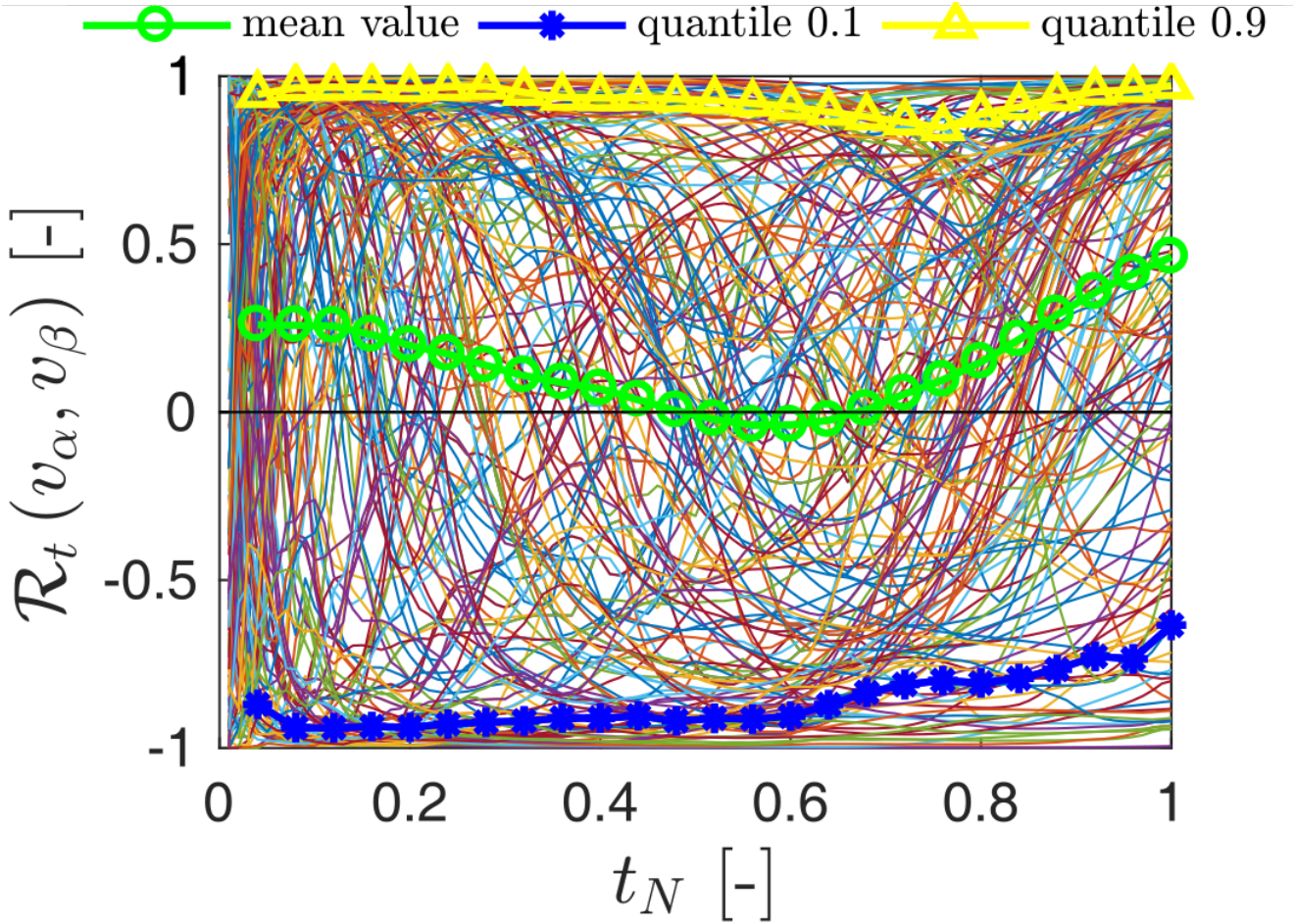

Summary

- Dependency between velocity and density
- Movement in a crowd is more complex
- Follower-leader concept

Thank you for your attention.