

Project title: To interact or not to interact? A study of collective motion of animal groups with non-reciprocal interactions.

This call is supported by the MITI project *Emergence of Collective Motion in Biological Intermittent Systems* (ECOMBIS).

Motion in animal collectives is a striking and widespread phenomenon in nature appearing across different scales. One key aspect observed in moving animal groups is the fact that individuals communicate in order to move or stop collectively. In some systems, this communication happens among individuals in a non-reciprocal way, for example individuals moving at the back of a group see all their conspecifics, but the individuals in the front do not see the ones in the back. The effect of such non-reciprocal interactions on collective motion of animal groups is poorly understood.

In this project, we aim to address this gap by studying the collective motion of groups of sheep, where single individuals have a visual apparatus that can increase or decrease their field of vision, that we call *the vision cone*. We intend to use a different degree of vision of the individuals in order to have a heterogeneous system. We plan to use groups of $N=2$ up to $N=30$ sheep, that will be positioned inside a large arena of around 80m x 80m of area. We will study how the spontaneous collective motion observed in groups of sheep [1] will be affected by the presence of non-reciprocal interactions that we can regulate via the angle of the vision cone. We will monitor the dynamics of the system by computing i) the positions, orientations and speeds of the individuals, ii) the cohesion of the group, and iii) the duration of the collective motion phases (CMPs). We intend to study different degrees of heterogeneity, going from almost homogeneous groups up to strongly heterogeneous groups.

The experiments will be implemented at the Domaine du Merle (Institut Agro Montpellier, Salon-de-Provence). This behavioral study will mainly focus on the acquisition of positional data of single individuals over time (examples: position, orientation & speed), that will be acquired using Global Navigation Satellite Systems (GNSS).

Keywords: Collective motion, non-reciprocal interactions, heterogeneous groups, biophysics.

Field site: Domaine du Merle, 13300 Salon de Provence, South of France.

Period of work: October to December 2026.

Salary: The candidate will receive a grant of around 614 €/month. Travel and stay expenses in the field will be paid by the project. Candidates will have to assume their living expenses. We encourage students to find additional support from their university, or from other institutions.

Required qualifications and skills: A candidate with a background in ethology or animal behavior (preferably at the master's level) who is interested in learning about digital monitoring of animal behavior—both in terms of tools and methodologies—or, alternatively, a candidate with a background in electronics, computer science, physics, or data analysis who wishes to apply their skills to the study of animal behavior.

The candidate will be based at a farm station, where he/she will receive training from professional shepherds to manage sheep both in barns and in open fields. They will also be responsible for the care of sheep involved in experimental studies, which requires a strong commitment throughout the entire week, including weekends, and close collaboration with the station staff.

The candidate will as well be responsible of the recording of the data (using GNSS) and experimental videos of the setup. Ideally, the candidate will assist as well on the processing and curation of the data, to obtain positions and orientations of individuals, but this is not mandatory.

The job involves physically demanding tasks related to handling adult sheep and includes working outdoors, often early in the morning and potentially in the evening. Fieldwork will be conducted in close cooperation with another student and occasionally with professionals during short fieldwork periods. Therefore, the ability to work effectively as part of a team is essential.

Although proficiency in French is not mandatory, it would be an advantage for working at the field station.

Interested candidates will have to contact:

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References

[1] *Intermittent collective motion in sheep results from alternating the role of leader and follower.*

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