Characterization of lab-based swarms of Anopheles gambiae mosquitoes

Stefania Melillo Collective Motions of Animals and Robots Cargese 31 May 2024



www.cobbs.it www.erc-rgbio.eu



Collective behavior



Starling flocks

Midge swarms

3D Experiments in the field









3D Tracking



Attanasi, A., et al. GReTA-A Novel Global and Recursive Tracking Algorithm in Three Dimensions. IEEE TPAMI (2015).

Insect Swarms Go Critical

Physics

Mosquito lab-swarms



CoBBS Lab in collaboration with University of Perugia Department of Medicine and Surgery

Malaria vector control



World Malaria Report 2023 – World Health Organization WHO



Malaria control strategies



MOSQUITO

Vector Control

Malaria vector control

S. Kumar and A. Sahgal, 'Advances in Mosquito Control: A Comprehensive Review', Advances in Diptera - Insight, Challenges and Management Tools. IntechOpen, 2022.

- Bias sex ratio towards males
- Make mosquitoes resistant to plasmodium

Malaria mating and swarming

Anopheles gambiae during mating: Source: Sam-Cotton, www.scienceupdate.com

Tests on vector control

what has been done?

Tests on vector control

how can we contribute?

Lab-swarms?

Mosquito Husbandry

Lab-swarms

Large cage setup

Mosquito Husbandry

3D Experiments

Lab-swarms

Large cage setup

3D Tracking

Attanasi, A., et al. GReTA-A Novel Global and Recursive Tracking Algorithm in Three Dimensions. IEEE TPAMI (2015).

3D Tracking: occlusions

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3D Tracking: occlusions

frame

3D Tracking Build all possible 2D trajectories

3D Tracking Build all possible 2D trajectories

3D Tracking Match across cameras

Use the geometry of the system to match objects across cameras

	AA	BB
AA	10	4
AB	7	7
BA	7	7
BB	4	10

	AA	BB
AA	10	4
AB	7	7
BA	7	7
BB	4	10

2 correct trajectories

3D Tracking Exponential proliferation

3D Tracking Exponential proliferation

3D Tracking Exponential proliferation

3D Tracking

Trajectories ~ 16s @170fps

28 acquisitions single-sex males

34 acquisition single-sex females

6 acquisitions mixed-sex

Participation Ratio

Lab-swarms participation ratio - males

Lab-swarms participation ratio - females

Lab-swarms males vs females

Lab-swarms males vs females

males

females

Exploration strategy

2

males

Exploration strategy males - loops

Exploration strategy males - loops

Exploration strategy males vs females

Exploration strategy males vs females

Exploration strategy males vs females

Mating how to detect mating events?

Mating competition

Mating competition

Future work

Let's distinguish females!

PRIN 2022 - MoSWARM

Thanks for your attention!

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A. Cavagna, I. Giardina, M. A. Gucciardino, G. Iacomelli, M. Lombardi, S. Melillo, G. Monacchia, L. Parisi, M. J Peirce, R. Spaccapelo Characterization of lab-based swarms of Anopheles gambiae mosquitoes Sci Rep 13, 8745 (2023).