



## Guido de Croon

**Research Statement:** Small, light-weight flying robots such as the 20-gram Delfly Explorer form an extreme challenge to Artificial Intelligence, because of the strict limitations in onboard sensors, processing, and memory. I try to uncover general principles of intelligence that will allow such limited, small robots to perform complex tasks.

### Work Experience

2013-now: Assistant Professor in the Micro Air Vehicle lab at Delft University of Technology

2011-2012: Research Fellow in AI, Advanced Concepts Team of the European Space Agency

March – December 2010: Lecturer at Radboud University Nijmegen

2008 – 2010: Researcher in the Aerospace Software Technologies Institute (ASTI) at Delft University of Technology

2003 – 2008: PhD-student in Artificial Intelligence at Maastricht University

Apr. – Sep. 2007: Research at the École Polytechnique Fédérale de Lausanne (EPFL), Switzerland, on gaze control for information gathering in order to drive a simulated car. Collaboration with Prof. Dario Floreano.

### Education

1998 - 2003: M.Sc. Knowledge Engineering, Maastricht University, Major: Artificial Intelligence

March – August 2003: M.Sc. thesis research at the Consiglio Nazionale della Ricerca, Rome. Subject M.Sc. thesis: relation between the mathematical properties of robotic neural controllers and their capacities. Collaboration with Prof. S. Nolfi.

1992 - 1998: VWO, Cobbenhagen College in Tilburg (Janssen-Cilag prize for exact sciences)

### Selected Awards

1st places at drone competitions: EMAM 2008, IMAV 2010, IMAV 2013.

Best paper awards at: ICIUS 2015, GECCO 2013, EvoIASP 2005.

Golden [HUMIES](#) 2013 for the “Search for a grand tour of the Jupiter Galilean moons”.



I investigate how drones can use *optical flow* to navigate as efficiently as honeybees. My goal is not just to transfer findings from biology to robotics, but also to generate new hypotheses on how insects navigate in their environment. Recently, I developed a surprising theory that allows drones to see distances with a single camera, and simultaneously provides a novel hypothesis on how honeybees can have distance-mediated responses.



Small robots will reach their true potential if they can operate as a *swarm*. The interactions between many (very limited) small robots with each other and their environment, can lead to the swarm solving tasks that individual robots would never be able to solve. I focus on both low-level aspects of drone swarming (how can they sense where the others are?) and higher level aspects such as how to design the swarm members' individual controllers to reach a global goal.



The *DelFly Explorer* is with its 20 grams currently still the lightest drone in the world able to fly completely by itself. It uses a 4-gram stereo vision system to see distances to obstacles in the environment, and has a computationally efficient controller that ensures obstacle avoidance if the sensing is correct. Currently, it can fly around a room, and I am working with the MAV-lab on extending its capabilities to explore an entire building and then return home.

### Public outreach

TV shows such as "De Kennis van Nu" and "Klokhuis", public lectures, e.g., at the "Museon" or at "Cinékids", articles in newspapers such as "Metro", "Volkskrant", sites as BBC technology.

### Selected publications

For a full list of my publications, please see my website.

(2016), de Croon, G.C.H.E., Monocular distance estimation with optical flow maneuvers and efference copies: a stability based strategy, in *Bioinspiration and Biomimetics*, vol. 11, number 1. (pdf)

(2016), Scheper, K.Y.W., Tijmons, S., de Visser, C.C., and de Croon, G.C.H.E., "Behaviour Trees for Evolutionary Robotics", *Artificial Life*

(2014), De Wagter, C., Tijmons, S., Remes, B.D.W., and de Croon, G.C.H.E., "Autonomous Flight of a 20-gram Flapping Wing MAV with a 4-gram Onboard Stereo Vision System", at the 2014 IEEE International Conference on Robotics and Automation (ICRA 2014).

(2013), de Croon, G.C.H.E., O'Connor, L.M., Nicol, C., Izzo, D., "Evolutionary robotics approach to odor source localization", in *Neurocomputing*, Volume 121, 9 December 2013, Pages 481–497

(2012), de Croon, G.C.H.E., de Weerd, E., De Wagter, C., Remes, B.D.W., Ruijsink, R. "The appearance variation cue for obstacle avoidance", in *IEEE Transactions on Robotics*, Vol. 28, Issue 2, pages 529-534.

(2009), de Croon, G.C.H.E., de Clerq, K.M.E., Ruijsink, R., Remes, B., and de Wagter, C. "Design, aerodynamics, and vision-based control of the DelFly" In the *International Journal on Micro Air Vehicles*, Volume 1, Number 2, pp. 71 – 97.



<http://www.bene-guido.eu/>



<https://www.youtube.com/user/microuav>



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