Integrating EHDA in autonomous drones for enhanced greenhouse crop protection

M. M. Novelli[1,2*], K. S. Moreira[2], L. L. F. Agostinho[2]
[1] Department of Control and Automation Engineering, Federal University of Minas Gerais, 31270-901, Brazil
[2] Lectoraat Water Technology, NHL Stenden, Leeuwarden, 8917 DD, Netherlands
*matheus.mnovelli@gmail.com

Introduction

The Dutch green house strategy foresees stricter rules regarding pesticide application for the coming years. Recognizing this urgent need, growers need to find solutions to keep protection at lower pesticide application volumes. RAAK smart greenhouse projects proposes the use of autonomous drones equipped with computer vision tools and EHDA systems. Such drones can identify plages and apply small amounts of pesticides with great precision.

Figure 1. Drone flying inside a greenhouse. Foto: PATS Indoor Drone Solutions

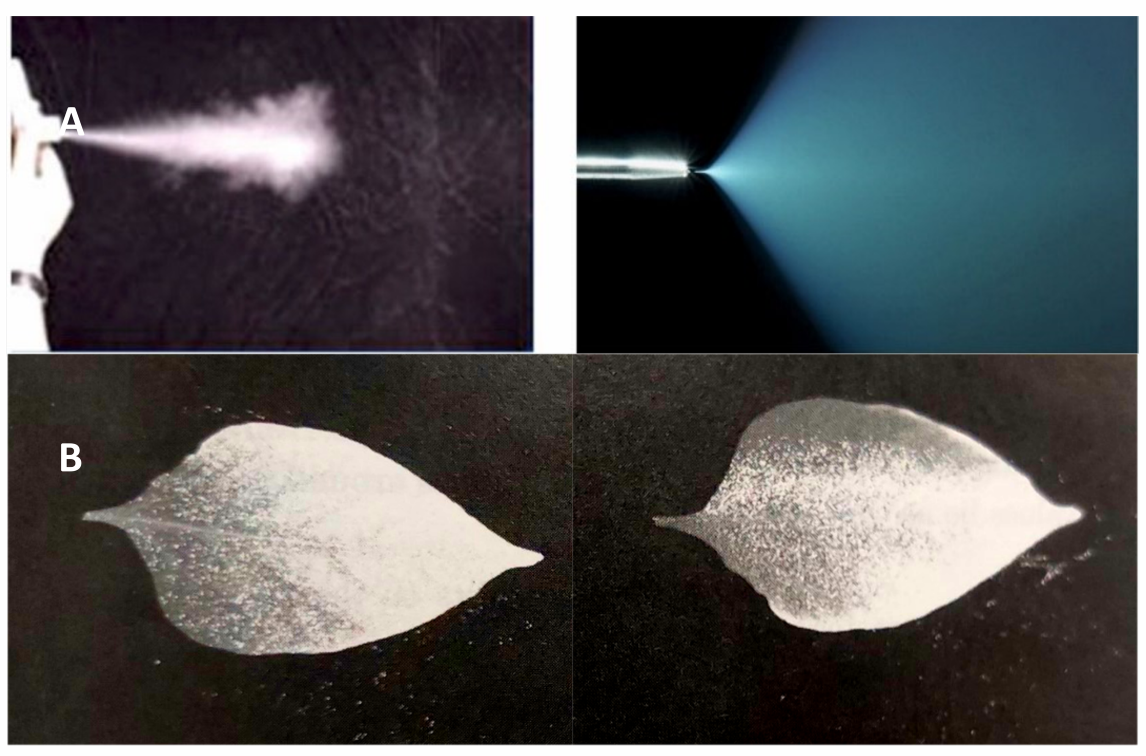

Figure 2. A) Phoographs of typical spray plume pattern vs. EHDA soft plume pattern; Source: Battelle Memorial Institute). **B)** Droplet deposition on a leaf with EHDA as spraying technique. Geerse, K.B., 2003.

Electrohydrodynamic atomization (EHDA) is a technique that uses strong electric fields to break-up a liquid into tiny and charged droplets.[1] This technique can offer a number of advantages that conventional pesticides applications systems can not. Among other things, the generated droplets have a surface charge, which enhances leaves coverage (Geerse, K.B., 2003).

Objective

In this project the implementation of an EHDA system in autonomous drones will be designed, tested and validated.

The specific objectives are:

- Determine the propeller impact on the electrospray behavior.
- Investigate possible influences of the electrospray on the drone functioning.
- Research into the miniaturization of the EHDA setup.
  - Electrical challenges
  - Hydraulic challenges
  - Nozzle miniaturization
- Physical-chemical characterization of mostly applied pesticides

Methods

The diagram below describes the activities flux which will be carried out during the project.

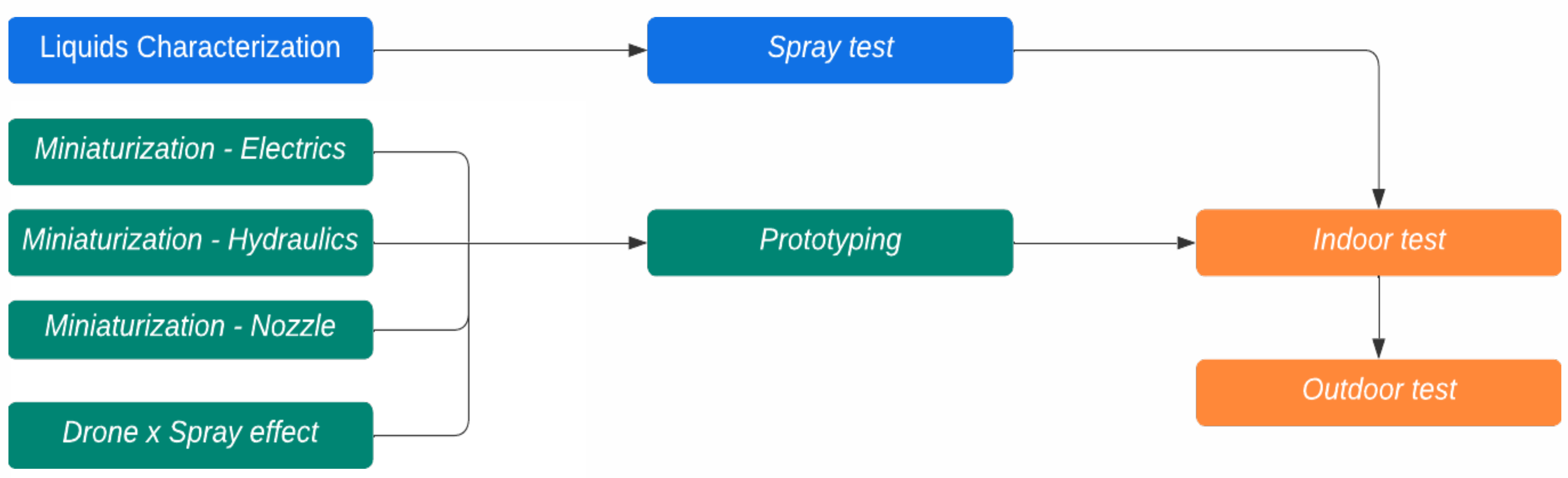

Figure 3. Activities flux diagram.

Results

Drone vs spray effect

Figure 4 presents first results obtained from the tests conducted to investigate possible influences of the drone propeller on the spray stability.

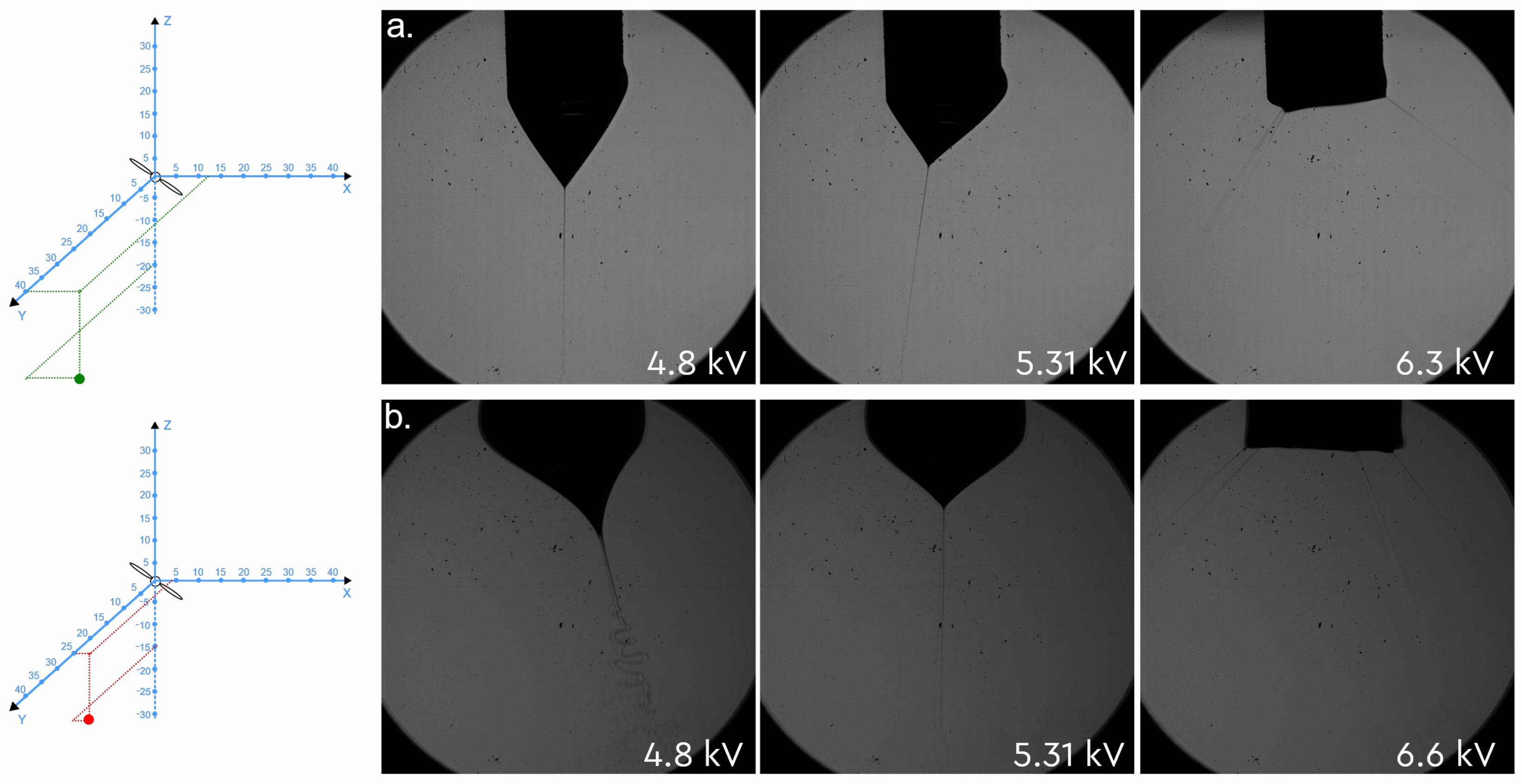

Figure 4. Electrospray at 12x40x20 cm (a.) and 4x25x15 cm (b.) in relation to the propeller, with different applied voltages.

Nozzle miniaturization

Geerse 2003 tests indicated that optimal (bottom and front) leave coverage was achieved with a nozzle to ring system and an upwards directed 10º. Based on the authors findings a first attempt for the nozzle which will be coupled in the drone was made (see figure 5).

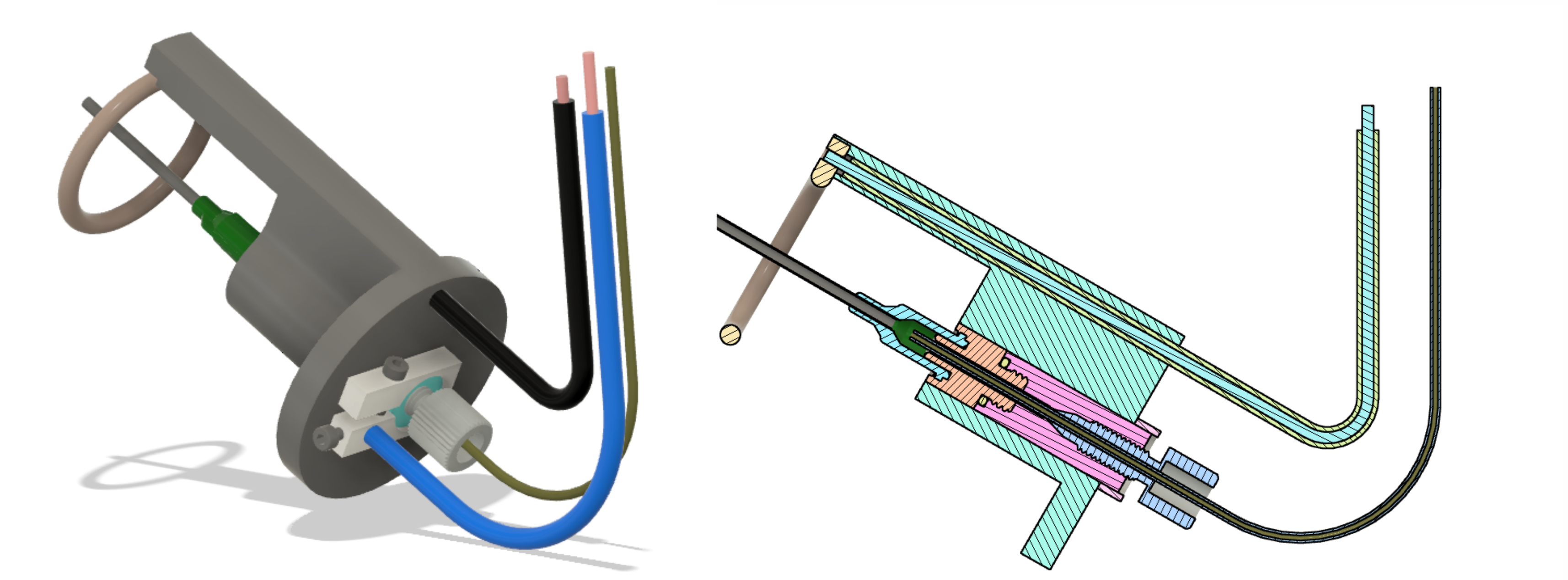

Figure 5. First prototype of the electrospray nozzle.

Conclusions

- Stability tests have shown influences of the drone propeller in distances up to 2m from the propeller axis.
- No influences were detected on the drone system from EHDA fields and operation.
- First physical prototype is designed. Electrical and hydraulic systems have to be designed and implemented.

References

[1] L. L. F. Agostinho, B. Bos, A. Kamau, S.P. Brouwer, E.c. Fuchs, J.C.M. Marijnissen, Simple-jet mode electrospray with water. Description, characterization and application in a single effect evaporation chamber

[2] Geerse, K.B., Applications of electrospray: from people to plants, 2003.

Acknowledgments

This work was conducted with the financial support of SIA Regieorgaan. The authors would like to thank the support given by Saxion Universities, Holstein Flowers, EveryDflowers, Vliegend.nl, ReCover, Venema precision mechanics and Federal University of Minas Gerais.