



Development of an experimental protocol to assess PWM spray valves using PIV

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Who are we (Who am I) ?



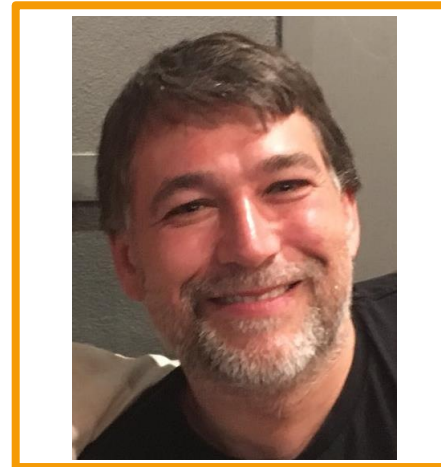
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Summary

1. Introduction
2. Materials and Methods
3. Results
4. Conclusion

01

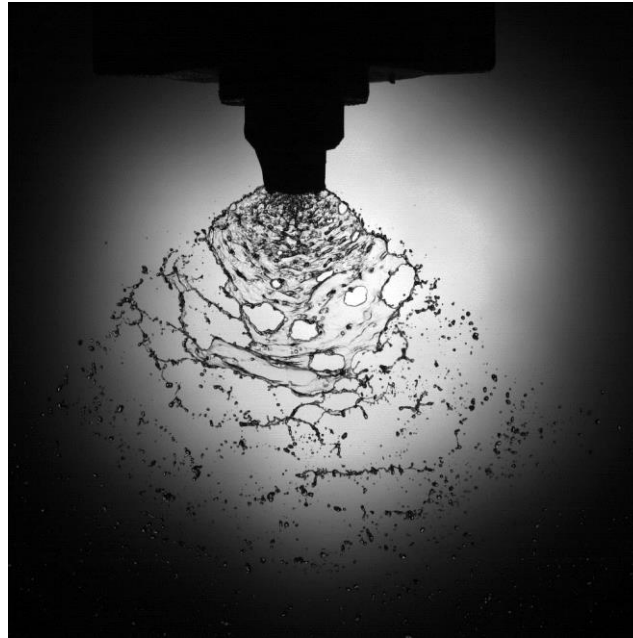
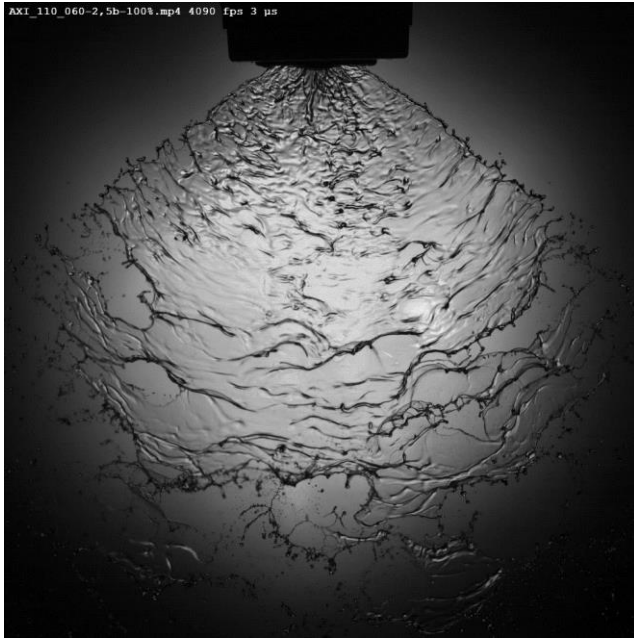
Introduction



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1- Spray, nozzles and limitations

Atomization and limitations

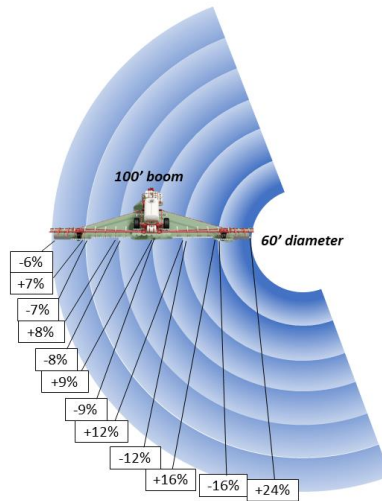


Pressure dependence of the flowrate
Modification of drops size and spray angle
Air inclusion principle

1- Spray, nozzles and limitations

Interest of PWM valves :

Flowrate is independent from pressure
Applicable to a single nozzle (spot spraying)
or a section (spraying while turning)



Capstan EVO

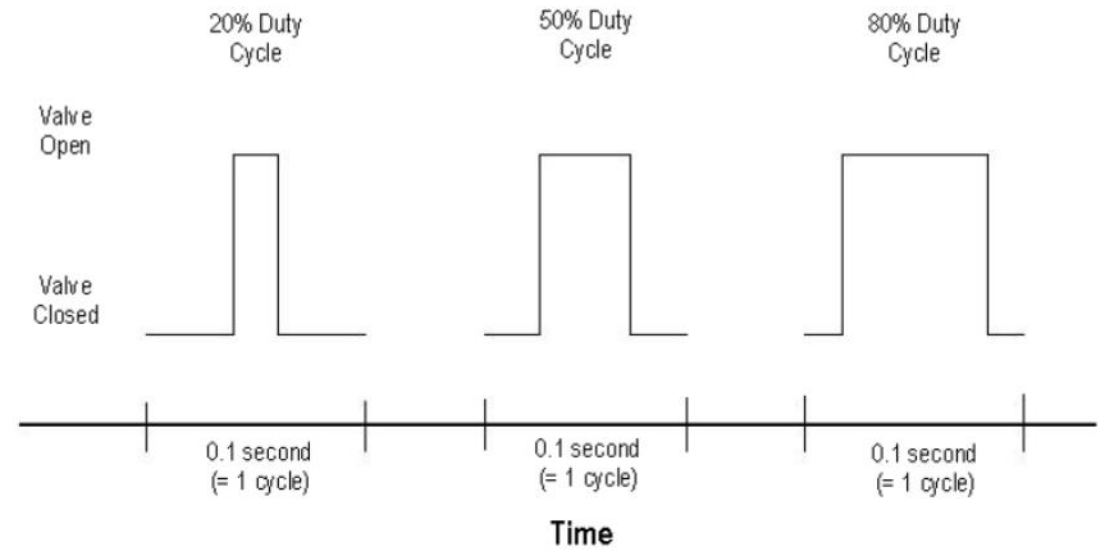


Figure 4. Illustration of the electrical signal pattern used to control the operation of solenoid valves. (Note the varying duration of valve opening among the waves. This technique is referred to as *pulse width modulation*)

02

Test bench



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2- Test bench

► High Speed Camera Keyence IDT OS3-S3

- CMOS sensor with a maximal resolution of 1280 x 1024 (1.3 MPix)
- 7000 frames per second at full resolution
- Shadowmetry mode



The nozzle is displaced up to 150 cm s^{-1} using a motorized boom ISEL LEZ 1
Step controller ISEL IT116 with step motor $25600 \text{ st. rev}^{-1}$

03

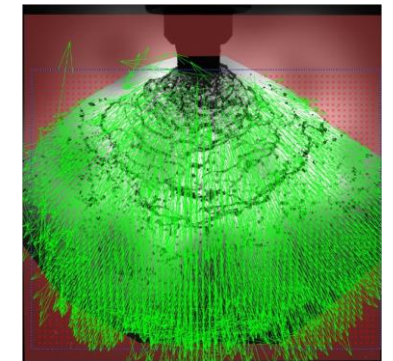
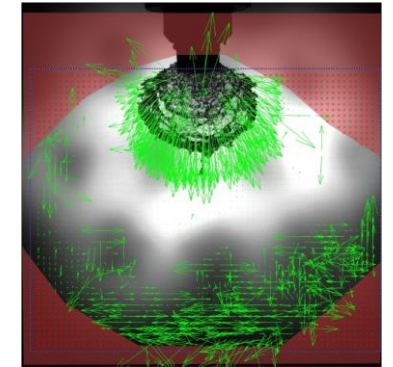
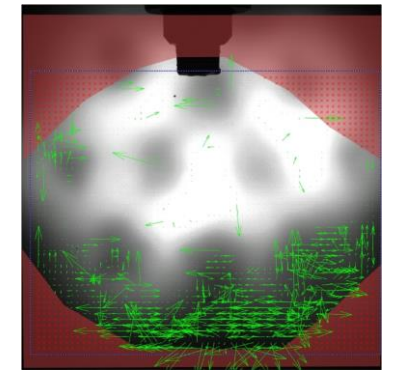
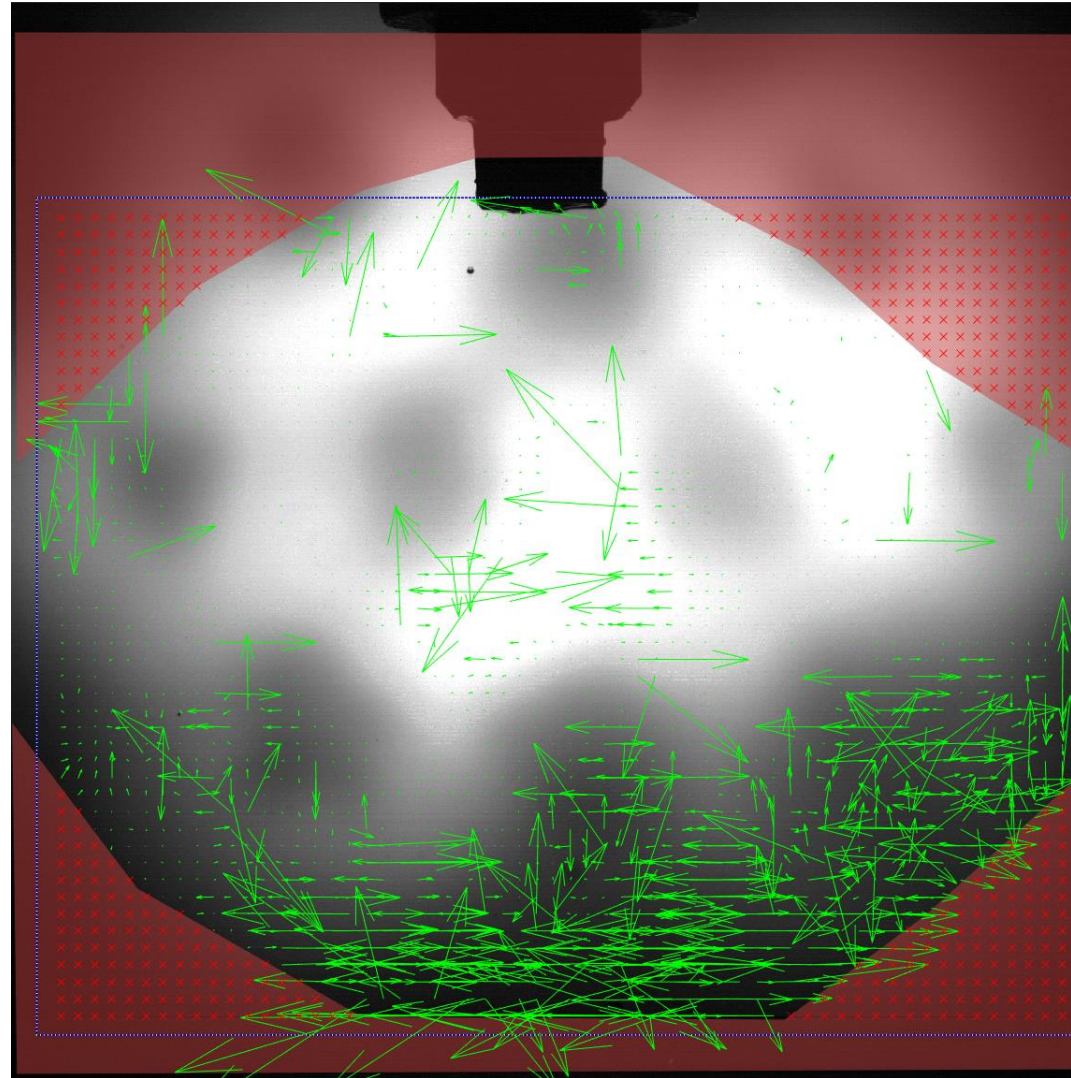
Results



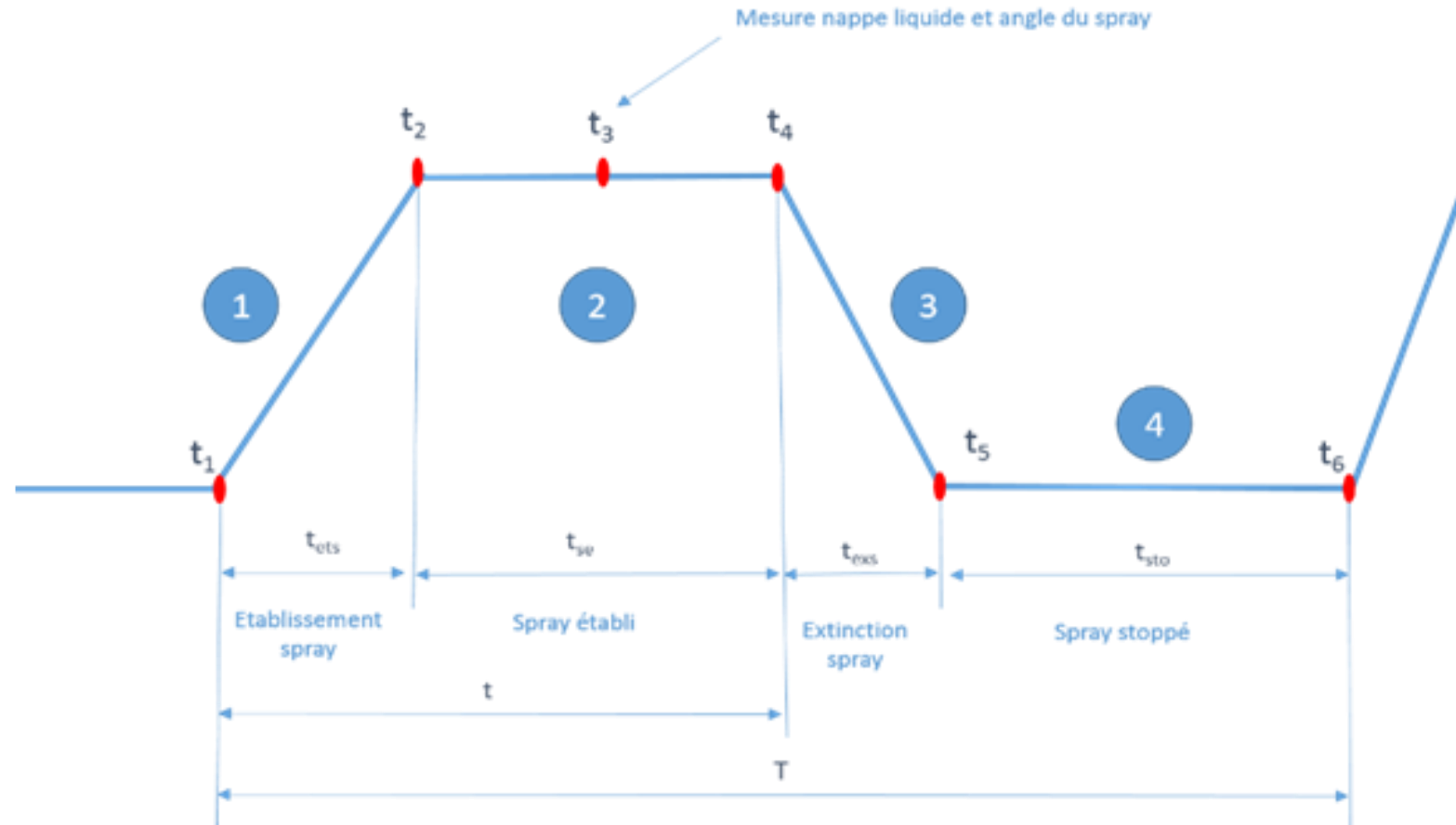
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3- PIV data

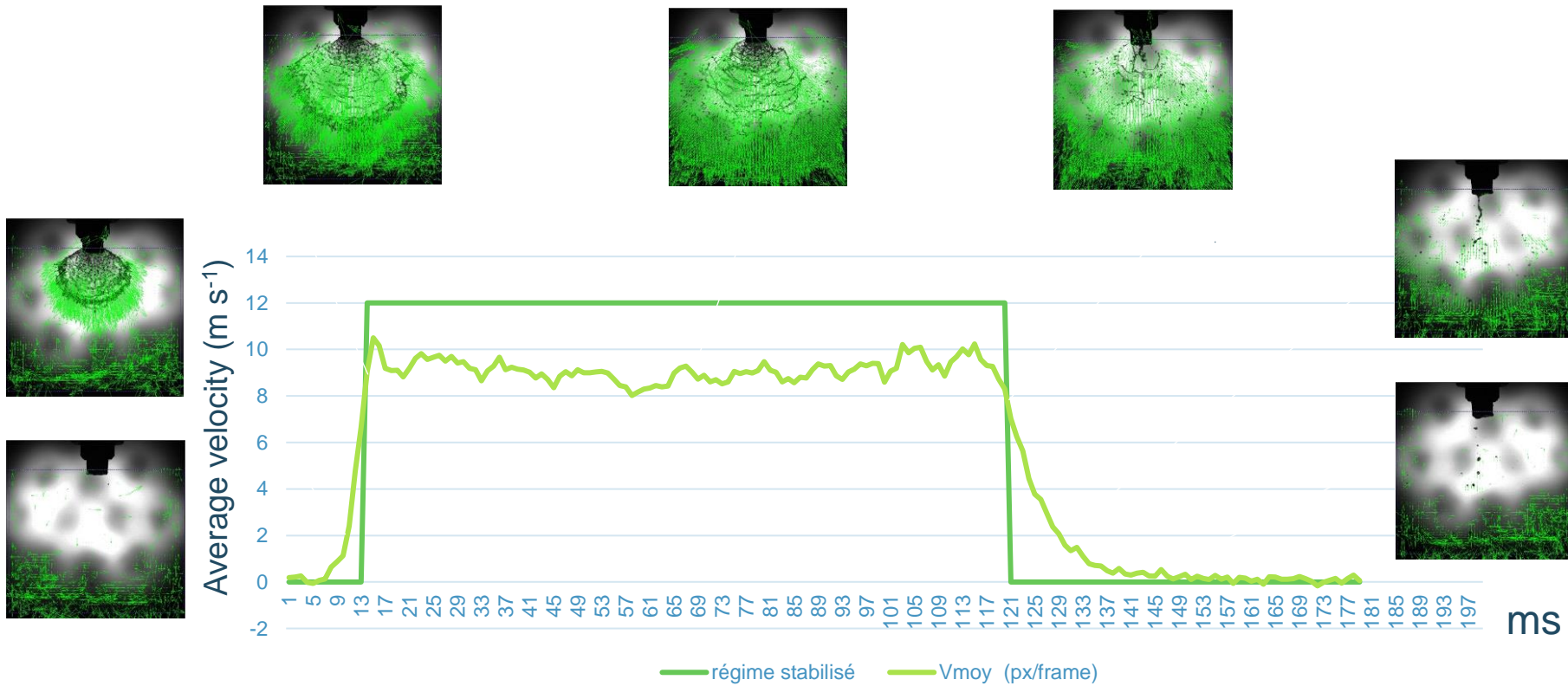
► Case of an
AI nozzle



3- PWM Steps

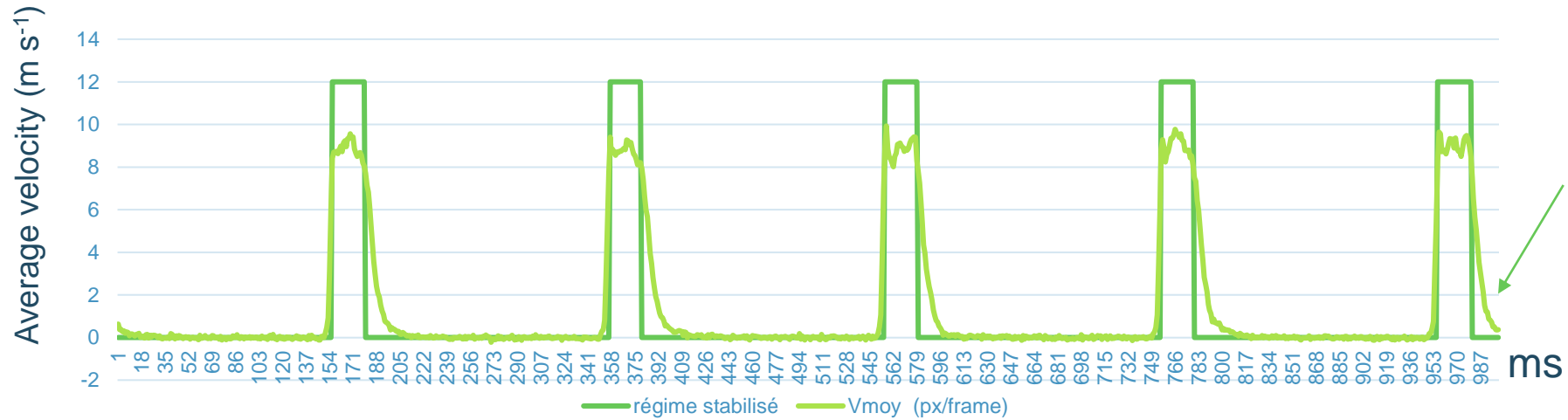


3- Results : Average velocity (m s⁻¹)



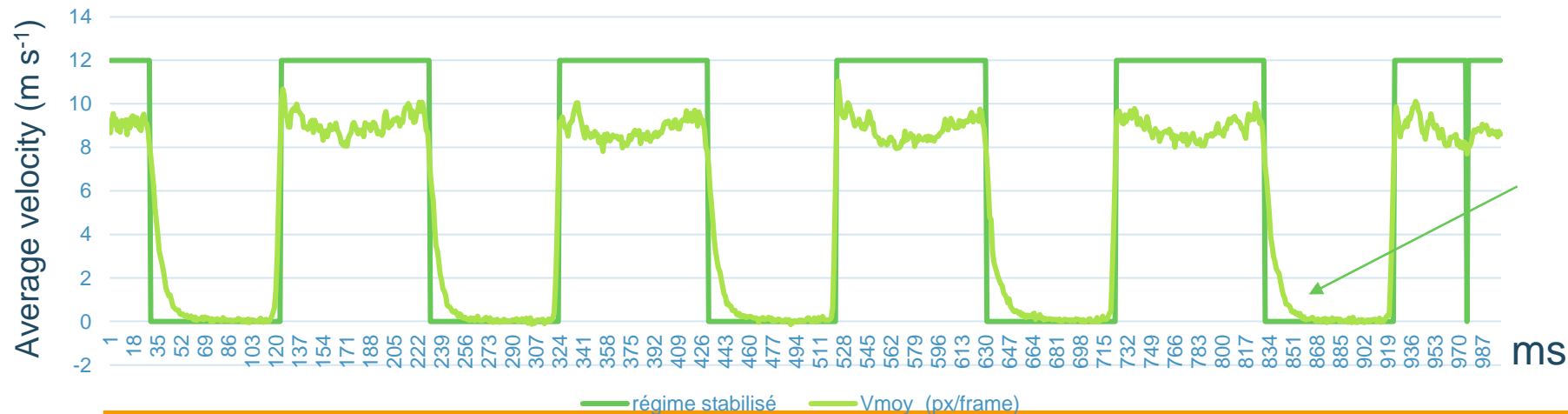
3- Results Average velocity (m s⁻¹)

CVI Marron 10%



Residual velocity
Total applied
volume 11.3%

CVI Marron 50%



Residual velocity
Total applied
volume 52.6%

04

Conclusion



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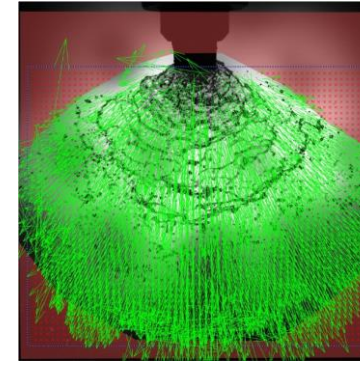
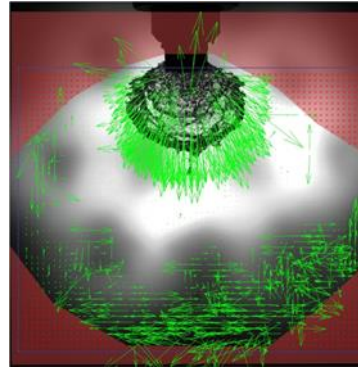
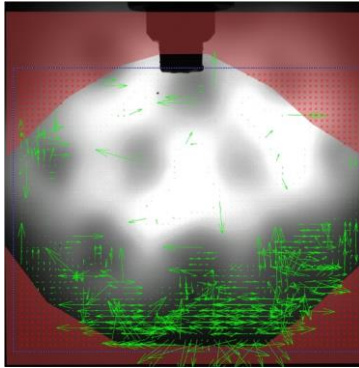
Conclusions

The system was design to study the compatibility of PWM with a range of nozzles (including AI nozzles)

The use of a high speed camera and PIV software allowed to evaluate the stability and flow regularity upon all steps of the cycle

Most of the issues were found at the end of the cycle where the residual volume may interfere after the valve shuts.

This device is also devoted to prototyping and studying different types of atomization process (deflector nozzles, twin fluid nozzles, ...)



QUESTIONS & ANSWERS

