# Development of measurement techniques based on image analysis for multiphase flows

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Supervisor: Prof. Gianluca Rossi

Meeting  -  16th September 2024

**Co- Supervised by:**
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Charachterizing air-water **two-phase** flows by measuring **velocity** and **shape of the bubbles**.

Through **image analysis based** techniques, it is possible to measure without altering the flow

**Measuring the shapes** of the bubbles = Optimize heat or mass transfer Measuring the **quantity of gas** that is flowing in the pipe

- A new methodology for measuring **bubbles velocity and shape** on a **non-pointwise** domain was presented.

- The technique was **developed and tested**. An experimental **uncertainty analysis** was conducted, with promising results.

- The basic hardware and ease of setup, suggest a **high potential for industrial application** where an **online monitoring** of a bubbly flow is required.
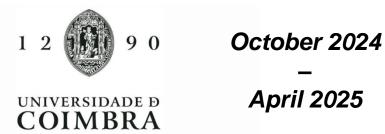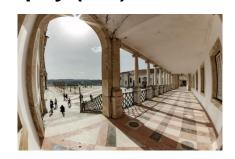
- The methodology will be used on images acquired **using a gamma-ray** source of light instead of the laser sheet (**lower λ**)

- A test campaign with **oil instead of water** is already scheduled

- The technique will be used as a **reference** for future analysis based on **Electrical Impedance Tomography (EIT)**

*October 2024 – April 2025*

## Attended Conferences:

- AIVELA annual meeting – December 2023
- Forum Nazionale delle Misure – September 2024

## Published Paper:

- **Tribbiani, G.**, Capponi, L., Rossi, G., Fabbiano, L. (2024). Exploring The Operational Limits of a Bolometric Camera for Thermoelastic Stress Measurementes Using a Photonic Reference Camera. *ACTA Imeko*
- **Tribbiani, Giulio**, et al. "Fiducial marker and blob detection-based motion compensation algorithm for Thermoelastic Stress Analysis measurements." *Journal of Physics: Conference Series*. Vol. 2698. No. 1. IOP Publishing, 2024.
- Zara, T., **Tribbiani, G.**, Ferranti, L., & Rossi, G. (2024, February). TSA and FEM Analysis Applied to CAD/CAM Titanium All-on-Four Prosthesis. In *Journal of Physics: Conference Series* (Vol. 2698, No. 1, p. 012002). IOP Publishing.
- Valenti, C., Massironi, D., **Tribbiani, G.**, Truffarelli, T., Grande, F., Catapano, S., Eramo, S., ... & Pagano, S. (2024). Accuracy of a new photometric jaw tracking system in the frontal plane at different recording distances: An in-vitro study. *Journal of Dentistry*, *148*, 105245.

| WBS NUMBER | TASK TITLE | % OF TASK COMPLETE | FIRST YEAR | | | | SECOND YEAR | | | | THIRD YEAR | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | T1 O N D | T2 J F M | T3 A M J | T4 J A S | T1 O N D | T2 J F M | T3 A M J | T4 J A S | T1 O N D | T2 J F M | T3 A M J | T4 J A S |
| 1 | Technology Scouting | | | | | | | | | | | | | |
| 1.1 | Identification of the problem | 100% | | | | | | | | | | | | |
| 1.1.2 | Identification of the limitations imposed by the installation | 100% | | | | | | | | | | | | |
| 1.1.3 | Selection of the most suitable techniques | 100% | | | | | | | | | | | | |
| 1.2 | Research on Conventional Techniques | 100% | | | | | | | | | | | | |
| 1.3 | Research on non Conventional Techniques | 100% | | | | | | | | | | | | |
| 2 | Definition of Experimental Test Benches | | | | | | | | | | | | | |
| 2.1 | Static Test Bench | 100% | | | | | | | | | | | | |
| 3 | Development of the Laser sheet measurement technique | | | | | | | | | | | | | |
| 3.1 | Measuring velocity and shape of a single bubble | 100% | | | | | | | | | | | | |
| 3.1.1 | Testing on synthetic videos | 100% | | | | | | | | | | | | |
| 3.2 | Measuring velocity and shape of multiple bubbles | 100% | | | | | | | | | | | | |
| 3.2.1 | Matching of the bubbles | 100% | | | | | | | | | | | | |
| 3.2.2 | Testing on synthetic videos | 100% | | | | | | | | | | | | |
| 3.3 | Assessment of the metrological performance on real data | 100% | | | | | | | | | | | | |
| 3.3.1 | Test bench tuning | 100% | | | | | | | | | | | | |
| 3.3.2 | Experimental Campaign | 100% | | | | | | | | | | | | |
| 4 | Development of the Electrical Impedance Tomography measurement technique | 5% | | | | | | | | | | | | |
| 4.1 | Visiting period at the University of Coimbra | 0% | | | | | | | | | | | | |
| 4.1.1 | Familiarize with EIT | 0% | | | | | | | | | | | | |
| 4.1.2 | Void fraction measurement | 0% | | | | | | | | | | | | |
| 4.1.3 | Flow rate measurement | 0% | | | | | | | | | | | | |
| 4.2 | Application of EIT to Nuovo Pignone test case | 0% | | | | | | | | | | | | |
| 3 | PhD related educational activities | | | | | | | | | | | | | |
| 3.1 | Courses attendance regarding fluid dynamics, image analys based measurement techniques, neural networks | - | | | | | | | | | | | | |
| 3.2 | Seminars and conferences | - | | | | | | | | | | | | |
| 3.3 | Scientific papers writing | - | | | | | | | | | | | | |
| 3.4 | Thesis Writing | - | | | | | | | | | | | | |