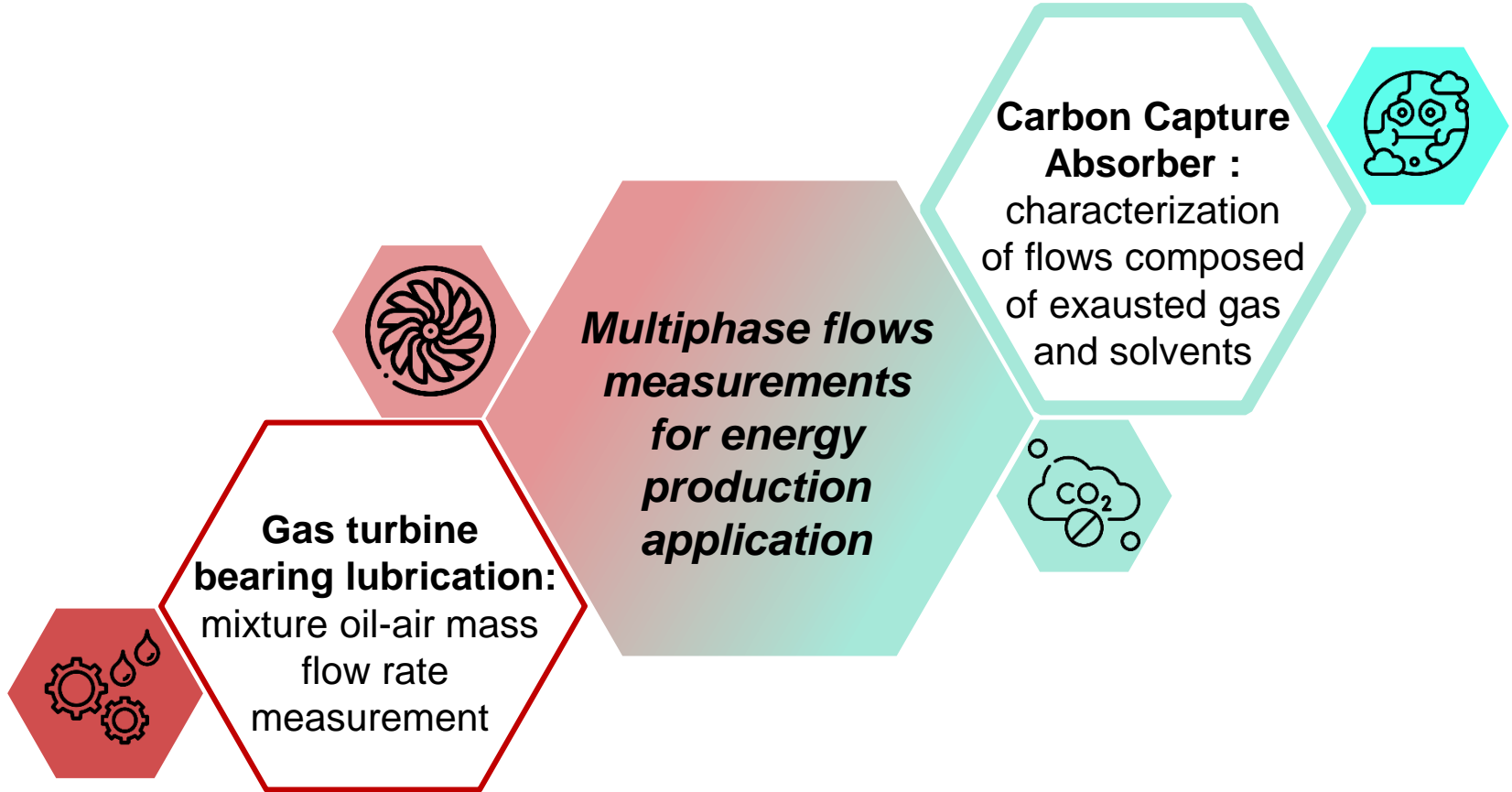# Development of measurement techniques for multiphase flows characterization in energy production applications

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Supervisor: Prof. Gianluca Rossi

Padova - 09 November 2022

Gas turbine bearing lubrication: mixture oil-air mass flow rate measurement

Multiphase flows measurements for energy production application

Carbon Capture Absorber : characterization of flows composed of exausted gas and solvents
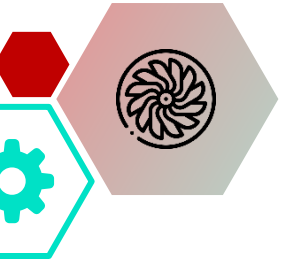
1

GAS TURBINE BEARING LUBRICATION
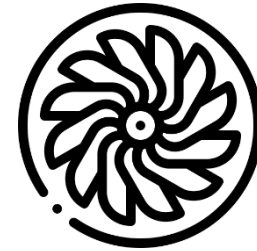
A stream of **pressurized air** is injected into the bearing to **keep the lubricant oil from leaking out**.

Hence a **two-phase flow is generated**.

The **mass flow rate of both phases** has to be measured.

The measurement system must be **housed inside the turbine enclosure**, therefore **many constraints** have to be taken into account.

CONSTRAINTS:

- **PIPE GEOMETRY** (inlet and outlet lubrication pipes are coaxial)
- **FREE SPACE** available inside the enclosure
- **TEMPERATURE** reached inside the enclosure (-20°C÷100°C)
- **FLAMMABLE SUBSTANCE** inside the measurement environment
- **OIL FOAMING** inside the pipe

A **preliminary test bench** has been designed to **simulate the working condition**. The first goal is to understand the **flow regime** inside the pipe, hence the right measurement technology can be found. Once perfected, the bench will be used to test the different solution found
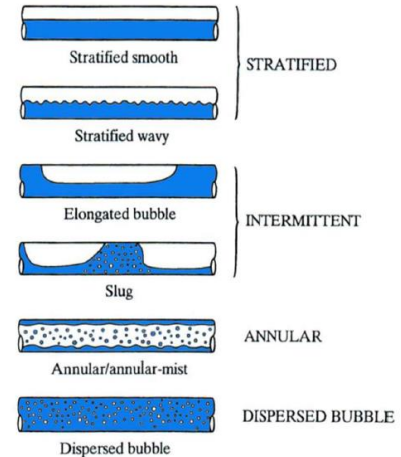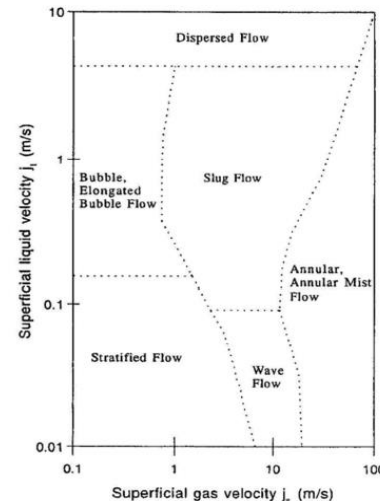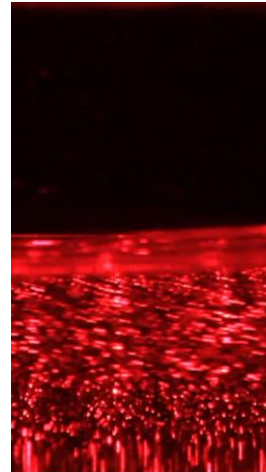
2 CHARACTERIZATION OF CARBON CAPTURE FLOW
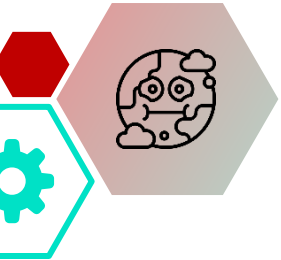
Carbon Capture per se is not an innovative technique; however, **exctracting CO_2 after combustion**, hence reducing the harmfulness of fumes released in the atmosphere, is a quite new and promising branch of this particular application.

MAIN CHALLENGE : succeed in extracting CO_2 with small scale machineries

Efficient methods of enhancing the exchange surface between exaust fluids and specific solvents have to be found
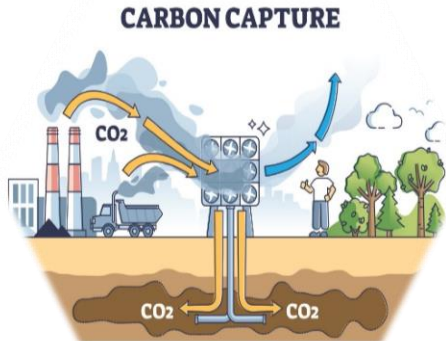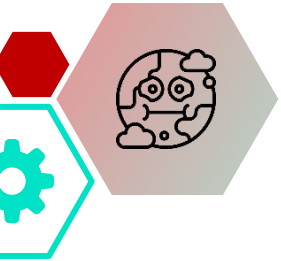
The **main purpose** of the meaurements will not be to measure the mass flow rate, but **to characterize the flow** (relative velocity between fluids, **dimensions of the contact area**, etc…)
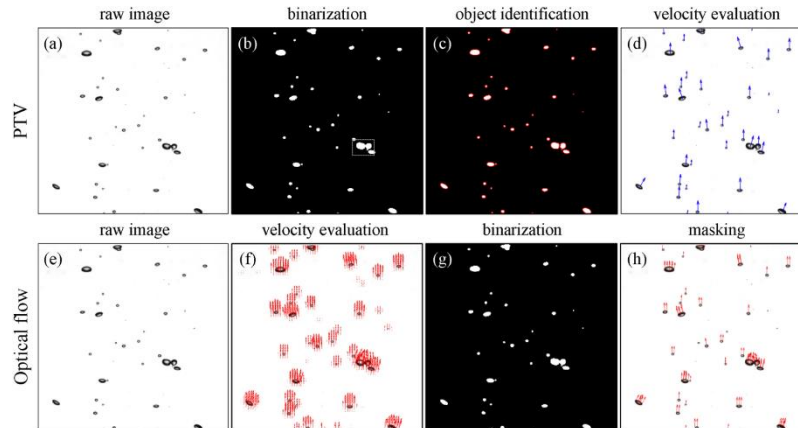
Image Analysis techniques combined to **Artificial Intelligence** could be promising in performing such measurements

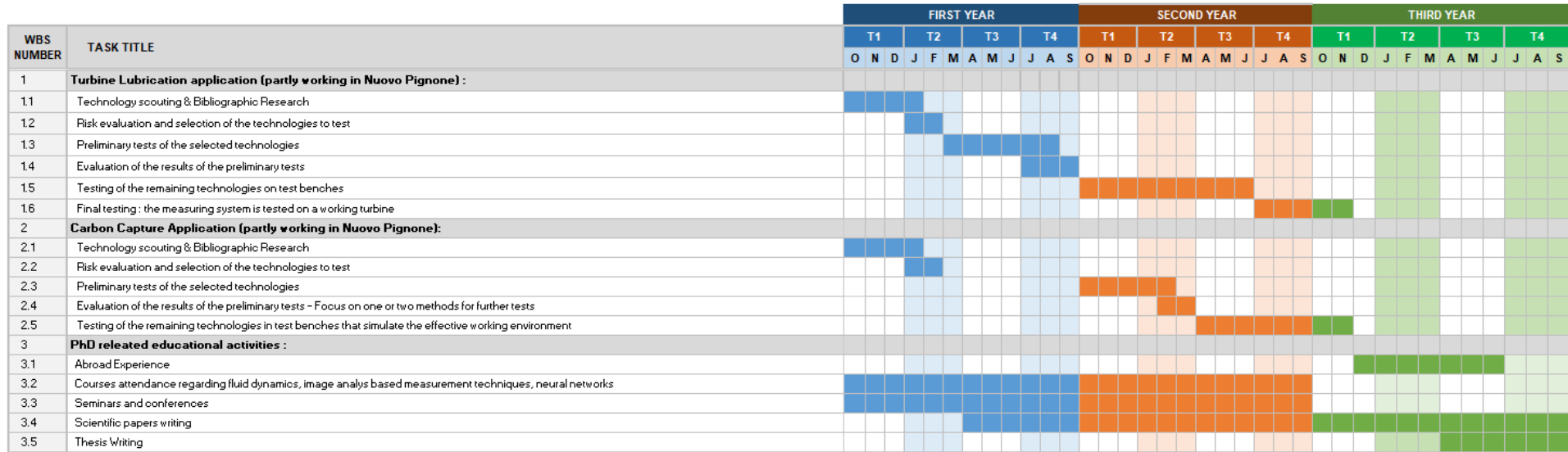| WBS NUMBER	TASK TITLE	FIRST YEAR				SECOND YEAR				THIRD YEAR			
		T1	T2	T3	T4	T1	T2	T3	T4	T1	T2	T3	T4
		O N D	J F M	A M J	J A S	O N D	J F M	A M J	J A S	O N D	J F M	A M J	J A S
1	**Turbine Lubrication application (partly working in Nuovo Pignone) :**												
1.1	Technology scouting & Bibliographic Research												
1.2	Risk evaluation and selection of the technologies to test												
1.3	Preliminary tests of the selected technologies												
1.4	Evaluation of the results of the preliminary tests												
1.5	Testing of the remaining technologies on test benches												
1.6	Final testing : the measuring system is tested on a working turbine												
2	**Carbon Capture Application (partly working in Nuovo Pignone):**												
2.1	Technology scouting & Bibliographic Research												
2.2	Risk evaluation and selection of the technologies to test												
2.3	Preliminary tests of the selected technologies												
2.4	Evaluation of the results of the preliminary tests – Focus on one or two methods for further tests												
2.5	Testing of the remaining technologies in test benches that simulate the effective working environment												
3	**PhD related educational activities :**												
3.1	Abroad Experience												
3.2	Courses attendance regarding fluid dynamics, image analys based measurement techniques, neural networks												
3.3	Seminars and conferences												
3.4	Scientific papers writing												
3.5	Thesis Writing												

Thanks for the attention