Metrological evaluation of lung ultrasound using virtual vector machine for diagnosis of acute respiratory distress syndrome

#### ME-LUS-VVM-DARDS



# Participating NMI and team

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### Main concepts

- Lung ultrasound (LUS)
  - Ultrasonography of lungs









- LUS "scores" (LUSS)
  - Semiquantitative score that measures lung aeration loss caused by different pathological conditions (ARDS, for instance)

### Main concepts

- Acute Respiratory Distress Syndrome (ARDS)
  - ARDS happens when the lungs become severely inflamed from an infection or injury
  - The inflammation causes fluid from nearby blood vessels to leak into the tiny air sacs in your lungs, making breathing increasingly difficult
  - COVID-19 may lead to ARDS in some circumstances





Radiography, not LUS

# Main concepts

### • Virtual Vector Machine (VVM)

- Supervised learning models with associated learning algorithms that analyze data for classification and regression analysis
- VVM C Machine Learning C Artificial Intelligence





### Motivation

- LUS is widely available
  - Easy to be used
    - Professional certification may be required
  - Relatively low cost
    - Comparing with radiology, for instance
  - Non-ionizing radiation
    - Proper dose measurement for IR is available
  - Accessible as Point of Care Testing (POCT)
    - Easy to be used, low cost, and non-ionizing



### • LUS has been successfully used to COVID-19 diagnosis

- A thousand or more papers had been published recently
  - A systematic review is undergoing
    - Cooperation of Inmetro and the Federal University of Rio de Janeiro (UFRJ)

# Key gyestions / hypothesis

- Is LUS safe for ARDS diagnosis?
  - That is partially responded by the project motivation



- Is LUS a proper metrological tool for ARDS diagnosis?
  - To be confirmed by the project outcomes
- Can VVM improve the rapidness for ARDS diagnosis?
  - Diagnostics accuracy is a premise
    - A comparison between a human and a VVM analysis is part of the methodology



# Challenges

- Metrology
  - LUS images accuracy to be checked
  - VVM accuracy to be checked



### Technology

- LUS as ARDS reliable diagnostics tool to be checked
- Methodology
  - Available LUS images databases completeness to be checked

# **Objectives**

- Main objective
  - Find out the applicability of VVM to help on the Diagnostics of ARDS (DARDS) based on LUS images

### Complementary objectives

- To find and check out LUS databases for ARDS
- To retrieve a large amount of data regarding LUS and ARDS
- To develop a VVM to categorize different LUSS based on LUS images
- To propose a tool to Diagnose Acute Respiratory Syndrome (DARDS) based on VVM





# Material and Methods

- Search for databases
  - LUS applicable to ARDS diagnosis
- Evaluate the integrity and reliability of the databases
  - Equipment used to extract the images
  - Post-extraction treatment
- Develop a VVM to categorize LUS images with respect to DARDS
  - Supervised tests
  - Accuracy check



### Main outcomes

An automated tool to diagnose ARDS based on different LUS

#### scores

- Technologically validated
- Metrologically validated
- Free to use worldwide
  - Industrial and Intellectual properties to be well-adjusted throughout the project
- Spread out knowledge of LUS, ARDS, VVM among SIM's NMI
  - Technical exchange
  - Internships
  - Culturalization on M4DT regarding ultrasound usefulness

#### MUCH MORE TO BE EXPLOITED

# Expected impacts

- Better, faster and more accurate diagnostics for ARDS
  - Based on a technical development project
- Easiness to apply the tool
  - M4DT as a dip-needle to forthcoming entrepreneurship on metrology agreed value investments
- POCT viability with an additional value on metrology
  - Metrology showing up as useful for a broader audience
- Health care and health tech investments
  - Circular and globally economy improvement
- Better communication with the population regarding the metrology

# Time schedule

- Warming up the engines
  - 140CT2021
    - Kick-off meeting
  - 270CT2021
    - Interaction and first planning

### Forthcoming activities

- 5 internships
  - To be arranged
  - Expected to be held from APR2022 to MAY2023
- Final meeting
  - Expected to be held on JUN-AUG2023
- Projected time span
  - OCT2021 to SEP2023 (24 months)



### Budget

### • Digital data storage in the clouds for 18 months

- USD 2k
- Scientist's exchange
  - USD 20k
    - Travelling support for 5 researchers
    - Air ticket and day allowance
    - Up to 4 weeks each
- Final meeting
  - USD 12k
    - Travelling support for 6 researchers
    - Air ticket and day allowance
    - Up to 4 days each

Total: USD 34 k



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Gracias Merci Obrigado Thank you

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