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

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INMETRO
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)
• 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
• Virtual Vector Machine (VVM)
  • Supervised learning models with associated learning algorithms that analyze data for classification and regression analysis
  • VVM ⊆ Machine Learning ⊆ Artificial Intelligence
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)
• 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

That is the utmost objective: DARDS
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
  - 14OCT2021
    - Kick-off meeting
  - 27OCT2021
    - 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)
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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