

# Collaboration with the CEPEL Electric Power Research Center of Brazil and UFF

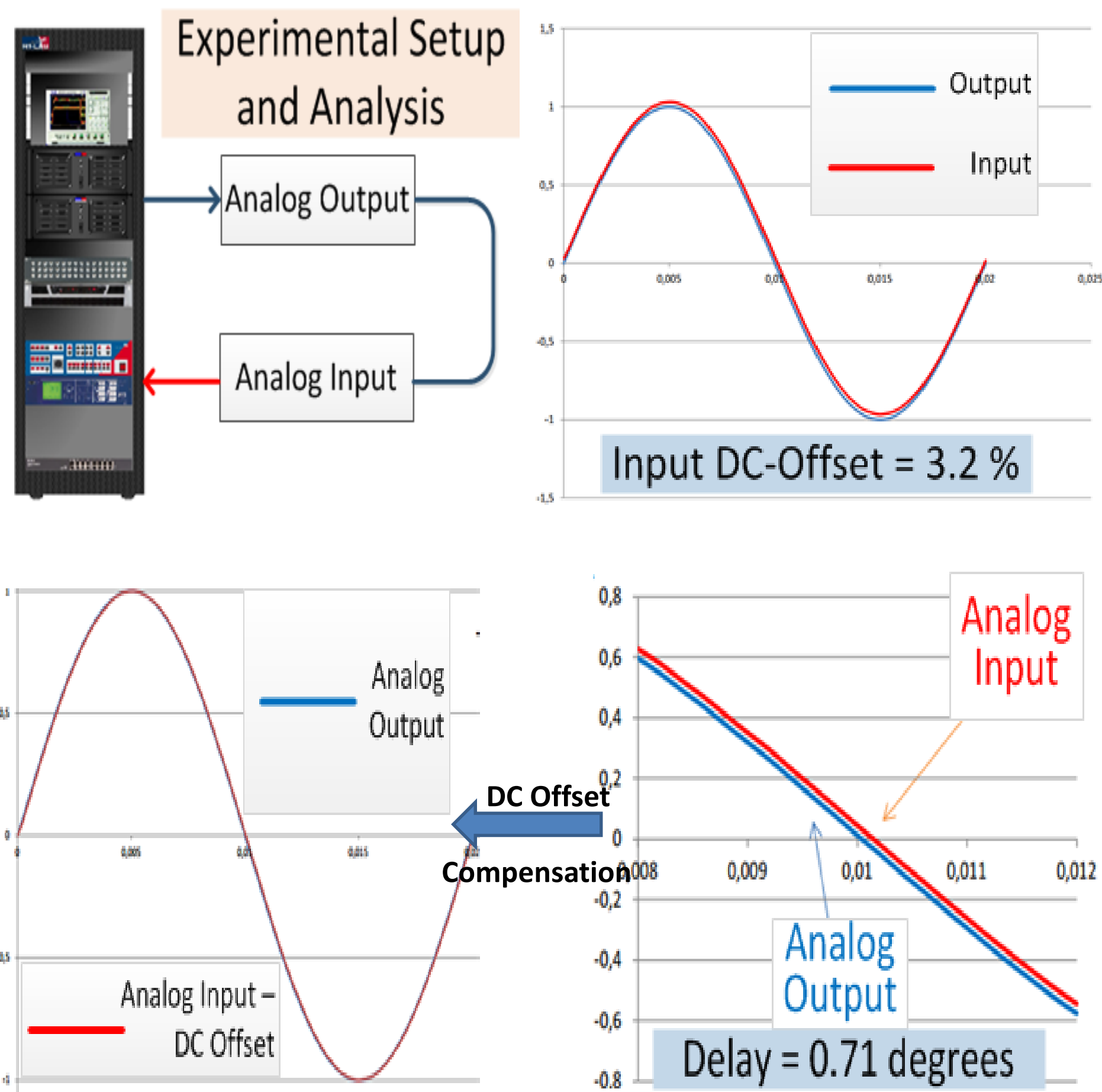
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## 1 .Introduction

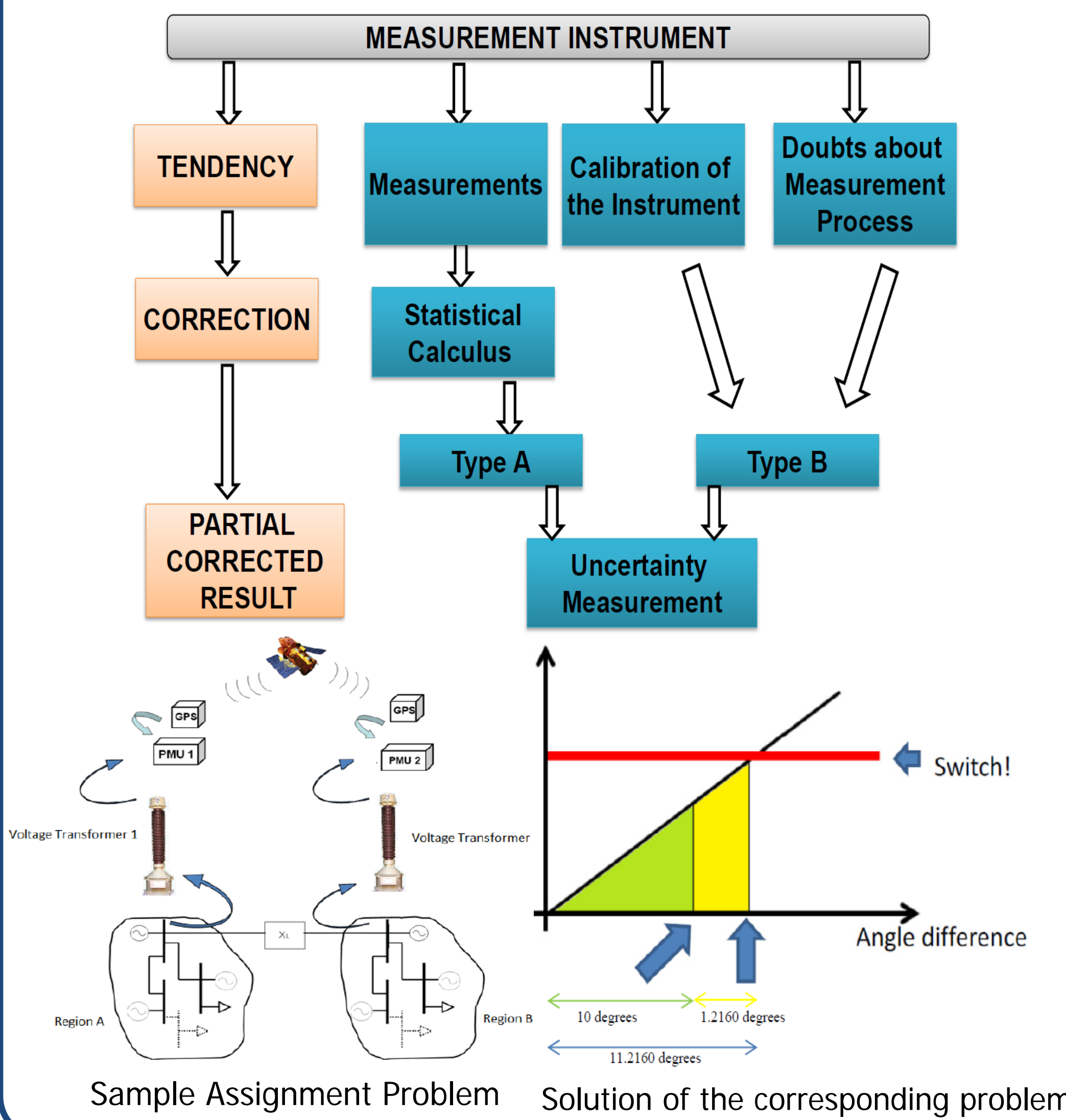
- CEPEL is the **greatest research center on energy and smart grid of the Southern Hemisphere**.
- Since 2013, SmarTS Lab has collaborated in the development of CEPEL's LabPMU, at the Distribution Technology Department.
- Through CNPq, the **collaboration** was strengthened by hosting the **sabbatical** of Prof. Jose Eduardo Alves Jr., **director of LabPMU**.
- LabPMU will serve the Brazilian industry in research and certification of synchrophasor/PMU technologies.
- Synchrophasor technologies are considered as a key for the implementation of smart grids and smart energy sys.
- KTH SmarTS Lab is a world-leading research team** and has 5 years of experience in **smart grid synchrophasor technology using model-based engineering systems methods**, including laboratory testing, verification and validation of PMU tech.
- This collaboration has served for **knowledge exchange and synergy with Brazilian academia, and industry**.

## 2. Joint Research Activities

- Real-time hardware-in-the-loop (RTHIL) simulation is a fundamental technology to verify the performance of synchrophasor technology.
- The research aims to characterize the uncertainty of RTHIL, and how to understand uncertainty in the PMU sensors in the context of synchrophasor applications. The following tasks were carried out:
  - Development of a RT Model por uncertainty characterization.
  - Investigating the uncertainties of instrumentation, PMUs considering field conditions.
  - Analyzing uncertainties regarding Hardware-in-the-Loop and open-loop simulation, including:
    - Amplifier uncertainties, RT Target uncertainties, PMU uncertainties
- Final aim:** to determine the sensibility of an application due to uncertainties of equipment and field conditions?

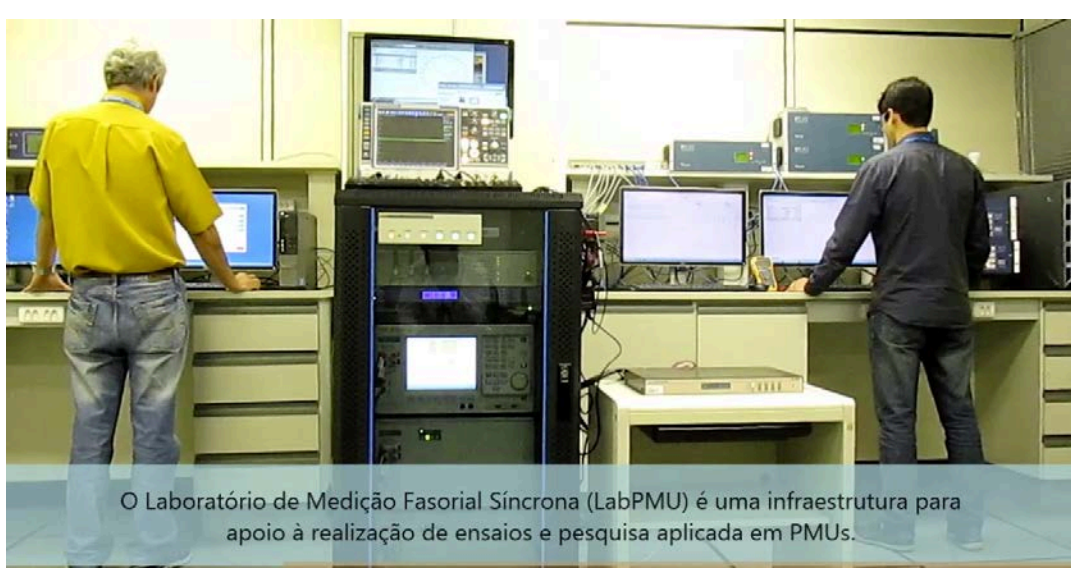


## 3. PhD Course at KTH by Course by Prof Alves



## 4. Future Synergies between LabPMU @ CEPEL and KTH SmarTSLab

### LabPMU @ CEPEL



### SmarTS Lab



- Development, Testing and V&V of software applications to be used in CEPEL's SAGE software.
- Sage is used by many transmission and distribution grid operators in Brazil, in their control rooms, and can adopt new applications developed by KTH SmarTS Lab.

