THE BRITISH UNIVERSITY IN EGYPT (BUE)

CENTRE FOR RENEWABLE ENERGY-WIND ENERGY DIVISION (CRE-WIND)

LABORATORY SETUP SUPPORTED BY THE WESET PROJECT

1- Introduction

The Centre for Renewable Energy at the BUE was established in October 2011. As a result of the WESET project, the BUE reorgam=nized the centre by creating three subdivisions, solar energy, wind energy and biomass division. The wind division was equipped with infrastructures that are funded by WESET project. Erasmus+ Project WESET project started initially in October 2017 and to address the needs of capacity building in the Wind Energy in Egypt and Tunisia. Tone of the project's objectives was to transfer knowledge and technology between experts in EU, Egyptian and Tunisian institutions in the field of Wind Engineering.

The CRE-Wind hosts a laboratory and training facilities for undergraduates, graduates and professional engineers interested in the Wind Energy field. It is integrated with an already exciting renewable energy lab located in room building B, Faculty of Engineering , The British University in Egypt. The supported WESET equipment for CRE-Wind focuses on the mechanical and aerodynamic part of wind Energy. Equipment related to electrical and control engineering are part of wind energy centre located in the AASTMT WEC.

2. BUE CRE-Wind Equipment

The equipment acquired by the CRE-Wind through the WESET project fund are:

- Hotwire anemometer for measuring mean and turbulent components of wind velocity
- Differential pressures transducer for measuring differential pressure
- Temperature transducer for measuring air temperature
- Barometric pressure transducer for measuring atmospheric pressure
- Data acquisition system for the above system components
- PM generators
- Torque/rpm transducers for wind turbine model measurements

- Workstations for wind energy related flow simulations.

Detailed specifications of the above equipment are listed in the following sections.

2.1 Hotwire anemometer with temperature transducer

aCTA hotwire bridge

SVMtec

Description

The acoustic CTA is a full-fledged hotwire bridge to perform dynamic flow velocity measurements in air. The calibrated velocity range goes up to 50m/s. Higher velocities are possible. Due to the measurement principle, the aCTA is particularly suitable for low flow velocities.The device can be used for other gases as well, in which case a special calibration is needed.

The aCTA is "plug and play" ready to use with hotwire probes of the type HWP10/xx. No presets or adjustments have to be made.
As output signal the device provides a voltage of ±10V. Based on the calibration data and the fluid temperature it can be converted into the flow velocity. An integrated 5kHz lowpass filter prevents alias-effects when using digital data aquisitions. Alternatively there is an unfiltered output for measurements up to 20kHz.

Additionally the flow fluctuations can be made audible through the provided headphones. This provides an intuitive and easy to use method to gain information about the quality of the flow. Aerodynamic phenomena like turbulence, flow separation, shear layers, or periodic detached flow can be heard. This provides a powerful tool to detect areas that are likely to cause acoustic noise.
The headphones can be plugged directly into the 3,5mm phone jack.

The power supply has a wide input range from 9 to 18V DC. This makes it easy to use in automotive applications as well.

Technical data

Hotwire probes	
HWP10/xx	
Ambient conditions for hotwire probes	
Fluid	Air, other non-corrosive gases possible
Temperature	-40°C ... 80°C
Humidity	non-condensing
No particles, no pollution	
Range	
Velocity 0 - 20m/s	0,1m/s + 0,5%v.M. (typ.)
Velocity 20-50m/s	1%v.M. (typ.)
Frequency resolution	0 - 20kHz (Bypass, low pass filter 5kHz)
Electrical characteristics	
Power-supply	9 - 18VDC, min. 0,5 A, 10W
Signal	±10V (Voltage < -2V: broken sensor)
Hotwire	max. 7V, max. 250mA
Headphones	min. 32Ohm
Ambient conditions	
Temperature	5°C ... 40°C
Humidity	non-condensing
Connectors	
Power supply / signal	Binder 711/712 4-pin
Signal	BNC
Hotwire	Binder 711 2-pin
Headphones	3,5mm phone jack
Dimensions	
aCTA bridge	150 mm x 56 mm x 24 mm
Ordering options	
Single (aCTA bridge only)	
Set: aCTA, power supply, headphones, 2 hotwire probes, case	

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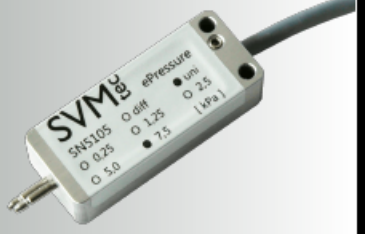
2.2 Differential pressures transducer for measuring differential pressure

ePressure V2.0 Pressure Sensor

SVMtec



Description

The pressure sensors of the ePressure series are especially optimised for dynamic measurements. Through the small dead volume inside the casing, frequencies up to 1 kHz can be resolved. Due to the compact design, the sensors can be mostly attached close to the measuring point to avoid damping caused by long hose lengths.

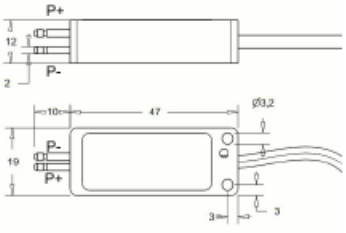
The ePressure v2.0 pressure sensors have a wide range voltage supply from 8 to 30 VDC. High frequency noise in the power supply must be avoided.

The pressure transducer work differential. They are available in an uni- or bidirectional design. Please specify the pressure range, the type of workload (uni- or bidirectional) and the cable length during your order. Additional connectors are upon consultation also available.

Technical Data

Pressure Range		
Unidirectional, 0 up to	0,25 | 1,25 | 2,5 | 5,0 | 7,5 | 10 | 25	[kPa]
Bidirectional, +/-	0,25 | 1,25 | 2,5 | 5,0 | 7,5 | 10 | 25	[kPa]
Safe Pressure Range	2,5 | 2,5 | 50 | 75 | 120 | 120 | 200	[kPa]
Burst Pressure	50 | 50 | 75 | 120 | 200 | 200 | 200	[kPa]
Signal		
Non-Linear & Hysteresis	0,25% max., typ. 0,05%	
Signal Delay	0,5ms	
Unidirectional	0,25 ... 4,25V	
Bidirectional	2,25 +/-2V	
Connections		
Connector	Binder 712 4-pol.	
Pin Allocation / Cable Colours	Pin1 Signal/Supply Gnd	green
	Pin2 Signal	white
	Pin3 Supply 8-30 VDC	brown
	Pin4	shield
Cable Length	1,5 m standard, other lengths on demand	
Pressure	Hose barb d = 2 mm	
Environment Conditions		
Temperature	0°C ... 60°C	
Humidity	non condesating	
Order Options		
Bidirectional		
Unidirectional		

Dimensions



2.3 Data acquisition system with Barometric pressure transducer for measuring atmospheric pressure

sDAQ Data Acquisition System

SVMtec

Description

The sDAQ data acquisition system is a special device, designed for analysing all necessary parameters of aerodynamics and fluid mechanics.

The 8-channel data acquisition module with a 16-bit resolution from National Instruments is the central element of the device. The in- and outputs of the data acquisition module are ready to use for instant connection with the following sensors:

- 1x PT100 temperature sensor
- 1x eCTA hotwire bridge
- 2x ePressure differential pressure sensors

An internal barometric pressure sensor is additionally built in. Thus all essential parameters of subsonic examinations can be tracked and analyzed. All remaining analog inputs are connected to BNC sockets.
The PC connection can be established by the built-in USB interface.

A simple data acquisition software is in the scope of delivery included. The software provides the configuration of the data acquisition card, reading the measured values, conversion to physical values and the storage of all collected data.
The supplied software is written with LabVIEW 2012 and will be delivered as stand-alone executable including its' source code. Software adaptions according to the user requirements can be easily done based on the supplied software. Therefor the NI LabVIEW 2012 software package is required which is in the scope of delivery not included.

Technical data

Data Acquisition	
8x Analog input	16 bit
	± 10 V, accuracy 6 mV full scale
	sampling rate (sum): 50 kS/s kHz
2x Analog output	16 bit
	± 10 V, accuracy ±7 mV
	Updaterate 5 kS/s
8x Digitale In-/Outputs	TTL (0-5 V)
1x Counter	32 bit / 5 MHz)
	TTL (0-5 V)
Further Internal Components	
PT100 amplifier	0...100 °C, default settings, configurable
Baronetric pressure sensor	800...1100 hPa
CTA-Mainboard	Supply eCTA and signal conditioning HD
Connections	
1x PT100 temperature sensor	Female connector Binder series 712 5-pol.
1x eCTA hotwire bridge	Female connector Binder series 712 7-pol.
2x ePressure sensor	Female connector Binder series 712 4-pol.
3x Analog input	BNC
2x Analog output	BNC
8x In- or output digital	D-Sub 9-pol.
1x Counter	Female connector Binder series 712 4-pol.
Supply	Female connector Binder series 712 2-pol.
USB female connector	
Equipment / Items delivered - Set	
1x sDAQ	
1x wall plug transformer 12 V / 1 A	
1x PT100 temperature sensor	
1x eCTA hotwire bridge	
2x HWP10/90 hotwire probe	
2x ePressure differencial pressure sensors, pressure range by customer's choice	
1x carrying case	
Data Acquision Software: sDAQview	
Options	
Making audible: Audio output of the hotwire signal + headphones	
DMS-Amplifier	

2.4 PM generators

Item # 1

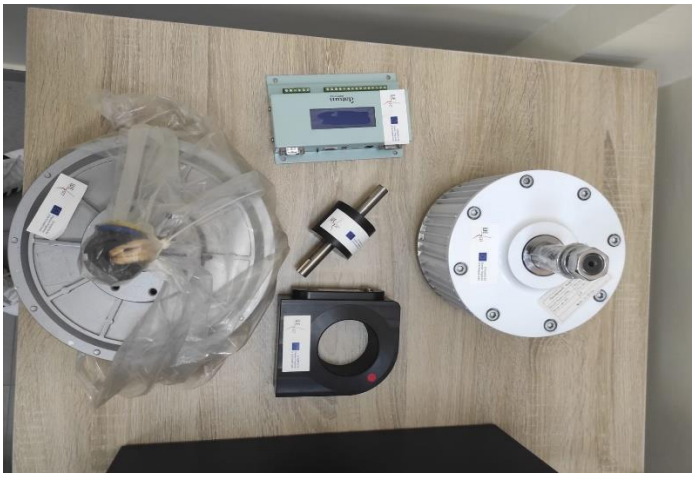
Permanent magnet DC electric generator 100 Watt @300 rpm 12 Volt for vertical axis wind turbine complete with charge controller (Voltage/current control charging-12 V-10 A)

Item # 2

Permanent magnet DC electric generator 200 Watt @300 rpm 12 Volt for horizontal axis wind turbine complete with charge controller (Voltage/current control charging-12 V-20 A)

Item # 3

Permanent magnet DC electric generator 500 Watt @350 rpm 12 Volt for vertical axis wind turbine complete with charge controller (Voltage/current control charging-12 V-20 A)



2.5 Torque/rpm transducers for wind turbine model measurements

- Device: Contactless Rotary Torque Transducer with speed and angle output (RS425-Datum).
- No off: 1
  - Maximum speed 15,000rpm.
  - Capacity 5.0 Newton Meters,
  - Safe working overload ±200%.
  - Sampling rate 2.5KHz.
  - Supply voltage 4 - 6VDC via USB, via
  - connecting USB cable to PC.
  - Window compatible Data logging
  - software included
  - Warranted Performance
  - Combined error ±0.1% Full-scale or better
  - Non-repeatability ±0.02% or better
  - Supplied with Windows compatible data logging software

TEMPERATURE
Effect on zero – %RO / °C ±0.02
Effect on output – % / °C ±0.01
Compensated +5 to +45

Operating range 0 to +60

- Device: Contactless Rotary Torque Transducer with speed and angle output (RS425-Datum).
- No off: 1
- Specifications:
  - Maximum speed 15,000rpm.
  - Capacity 10.0 Newton Meters,
  - Safe working overload ±200%.
  - Sampling rate 2.5KHz.
  - Supply voltage 4 - 6VDC via USB, via
  - connecting USB cable to PC.
  - Window compatible Data logging
  - software included
  - Warranted Performance
  - Combined error ±0.1% Full-scale or better
  - Non-repeatability ±0.02% or better
  - Supplied with Windows compatible data logging software

TEMPERATURE
Effect on zero – %RO / °C ±0.02
Effect on output – % / °C ±0.01
Compensated +5 to +45

Operating range 0 to +60

RS425 Performance Information

RS425 SERIES	Size 1 A-D*	Size 2 A-B*	Size 3 A-B*	Size 4 A-B*	Size 5 A-B*
Torque range	0-100Nm	0-500Nm	0-2,000Nm	0-10,000Nm	0-30,000Nm
Accuracy class	0.1%FSD	0.1%FSD	0.1%FSD	0.1%FSD	0.1%FSD
Mechanical connection	Keyway or Spline Shaft				
Signal outputs	RS485 as standard				
Optional outputs with DUI	**DIGITAL:** USB, Ethernet, RS485/232 and USB memory logging. **ANALOGUE:** 3 Channels of Torque, Speed and Power as 0-10V/4-20mA.				
Transmission	Strain gauge signal, digital on-shaft with inductive loop				
Standard speed (rpm)	10,000rpm	10,000rpm	6,000rpm	5,000rpm	2,000rpm
Max speed (rpm)	30,000rpm	20,000rpm	16,000rpm	10,000rpm	5,000rpm
Output data	1-4000sps				

*Please see next page for more details

2.6 Workstations for wind energy related flow simulations.

Workstation 1

Operating system
Windows 10 Pro for Workstations 64
Processor
Dual Intel Xeon Gold 6144 (16C 3.5GHz-4.2GHz 24MB L3 cache)

Chipset
Intel® C612
Memory
128 GB – Maximum Up to 256 GB DDR4-2400 ECC registered SDRAM DDR4-2133 ECC Registered SDRAM
Internal drive
250GB PCIe SSD + 1TB 7200RPM

Storage controller
Integrated SATA 6.0 Gb/s; LSI MegaRAID® 9270-8i SAS 6.0 Gb/s ROC RAID Card and iBBU09 Battery Backup Unit
Optical drive
Slim SATA DVD-ROM
Peripherals
1 keyboard
1 optical wireless mouse
1 24 in LED display 1920x1080 HDMI and VGA ports
Graphics
NVIDIA® Quadro® P1000 (4 GB)
Expansion features
Ports
Front:
4 USB 3.0
1 microphone
1 headset

Back:
4 USB 3.0
2 USB 2.0
2 PS/2
1 RJ-45
1 audio line in

1 audio line out

Network interface
LAN Integrated Intel® I218LM PCIe GbE
Intel® 7260 802.11a/b/g/n PCIe WLAN

Workstation 2

Operating system
Windows 10 Pro for Workstations 64
Processor
Dual Intel Xeon Gold 6144 (16C 3.5GHz-4.2GHz 24MB L3 cache)
Memory
64 GB – Maximum Up to 256 GB DDR4-2400 ECC registered SDRAM DDR4-2133 ECC Registered SDRAM

Internal drive
500 GB SATA SED (7200 rpm)
Storage controller
Integrated SATA 6.0 Gb/s; LSI MegaRAID® 9270-8i SAS 6.0 Gb/s ROC RAID Card and iBBU09 Battery Backup Unit

Optical drive
Slim SATA DVD-ROM

Peripherals
1 keyboard
1 optical wireless mouse
1 24 in LED display 1920x1080 HDMI and VGA ports

Graphics
NVIDIA® Quadro® P1000 (4 GB)
Expansion features

Ports
Front:
4 USB 3.0
1 microphone
1 headset

Back:
4 USB 3.0
2 USB 2.0
2 PS/2
1 RJ-45
1 audio line in

1 audio line out

Network interface

LAN Integrated Intel® I218LM PCIe GbE

Intel® 7260 802.11a/b/g/n PCIe WLAN

Workstation 3

Operating system
Windows 10 Pro for Workstations 64
Processor
Dual Intel Xeon Gold 6144 (16C 3.5GHz-4.2GHz 24MB L3 cache)

Chipset
Intel® C612
Memory
128 GB – Maximum Up to 256 GB DDR4-2400 ECC registered SDRAM DDR4-2133 ECC Registered SDRAM
Internal drive
250GB PCIe SSD + 1TB 7200RPM

Storage controller
Integrated SATA 6.0 Gb/s; LSI MegaRAID® 9270-8i SAS 6.0 Gb/s ROC RAID Card and iBBU09 Battery Backup Unit
Optical drive
Slim SATA DVD-ROM

Peripherals
1 keyboard
1 optical wireless mouse
1 24 in LED display 1920x1080 HDMI and VGA ports
Graphics
NVIDIA® Quadro® P4000 (8 GB)
Expansion features
Ports
Front:
4 USB 3.0
1 microphone
1 headset
Back:
4 USB 3.0
2 USB 2.0
2 PS/2
1 RJ-45

1 audio line in
1 audio line out

Network interface

LAN Integrated Intel® I218LM PCIe GbE
Intel® 7260 802.11a/b/g/n PCIe WLAN

3. Courses at the CRE-Wind

- Introduction to Wind Energy
- Mechanical systems in wind engineering
- Mechatronics in Wind conversion process
- Implementation of Wind Energy Systems
- Operation, maintenance and troubleshooting in wind turbines
- CFD Simulations and modelling
- Wind farm modelling