Methods of calibration of new device for human blood pressure measurement

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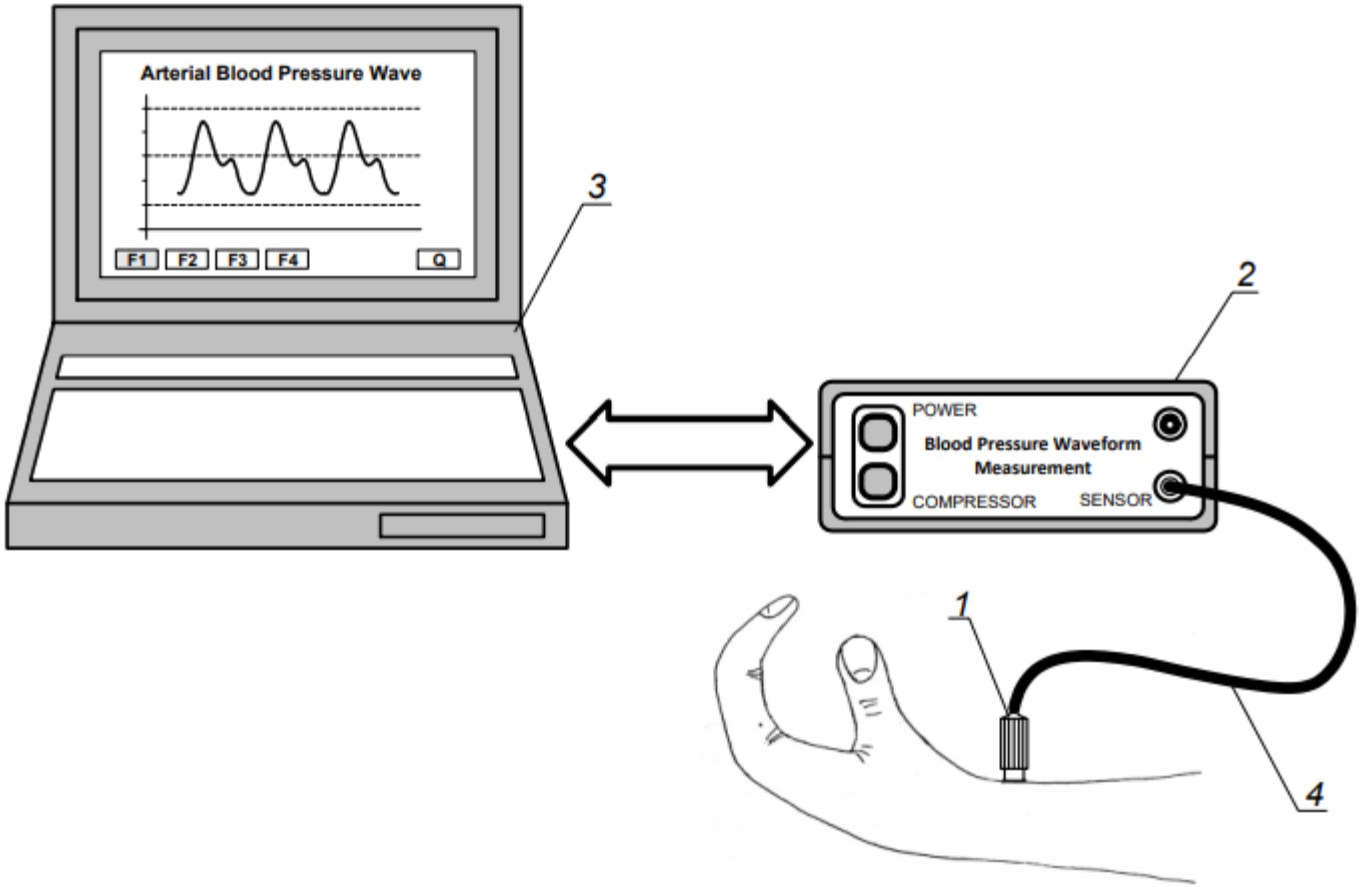
New pneumatic device for blood pressure measurement



1 – pneumatic sensor, 2 – power/pressure supply, 3 - PC, 4 – pneumatic cable

Experiment description

Calibration of new device was conducted on parallel with pre-validation process.

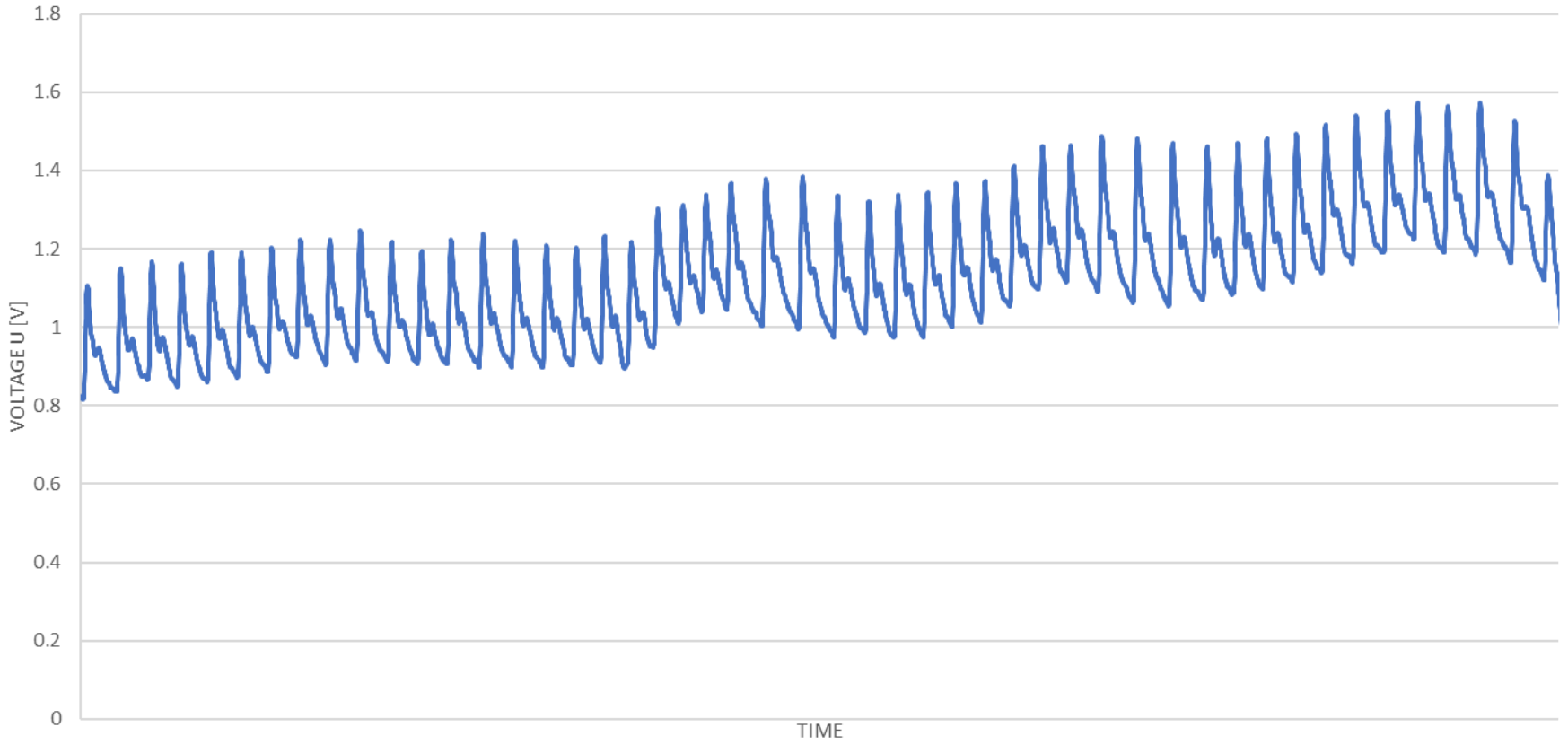
Research was conducted on 15 people with accordance to International Protocol for Validation of Blood Pressure Measuring Devices in Adults.

The chosen reference device was Sphygmomanometer Erka Perfect.

Picture 1. Sphygmomanometer Erka Perfect

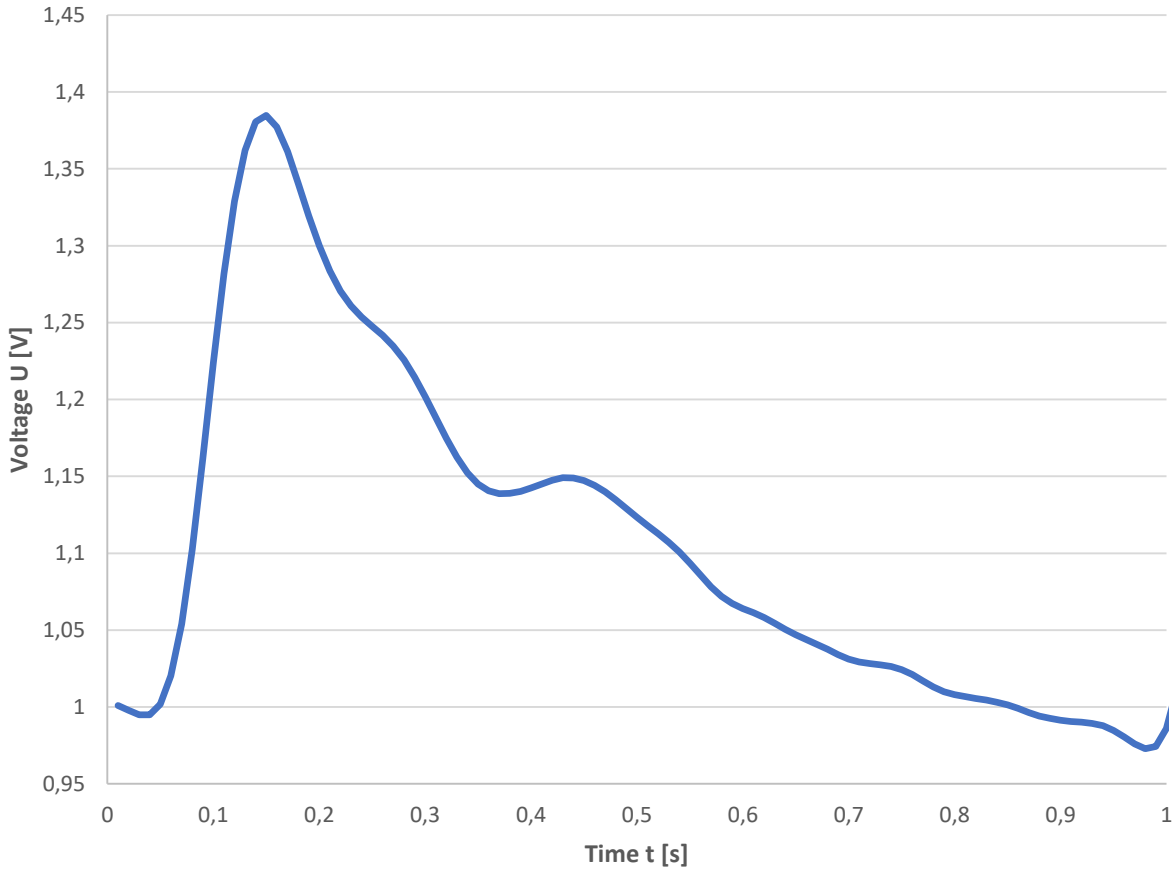
Source: https://www.erka.org/en/blood-pressure-measurement/perfect-aneroid-48/56

Example of recorded data



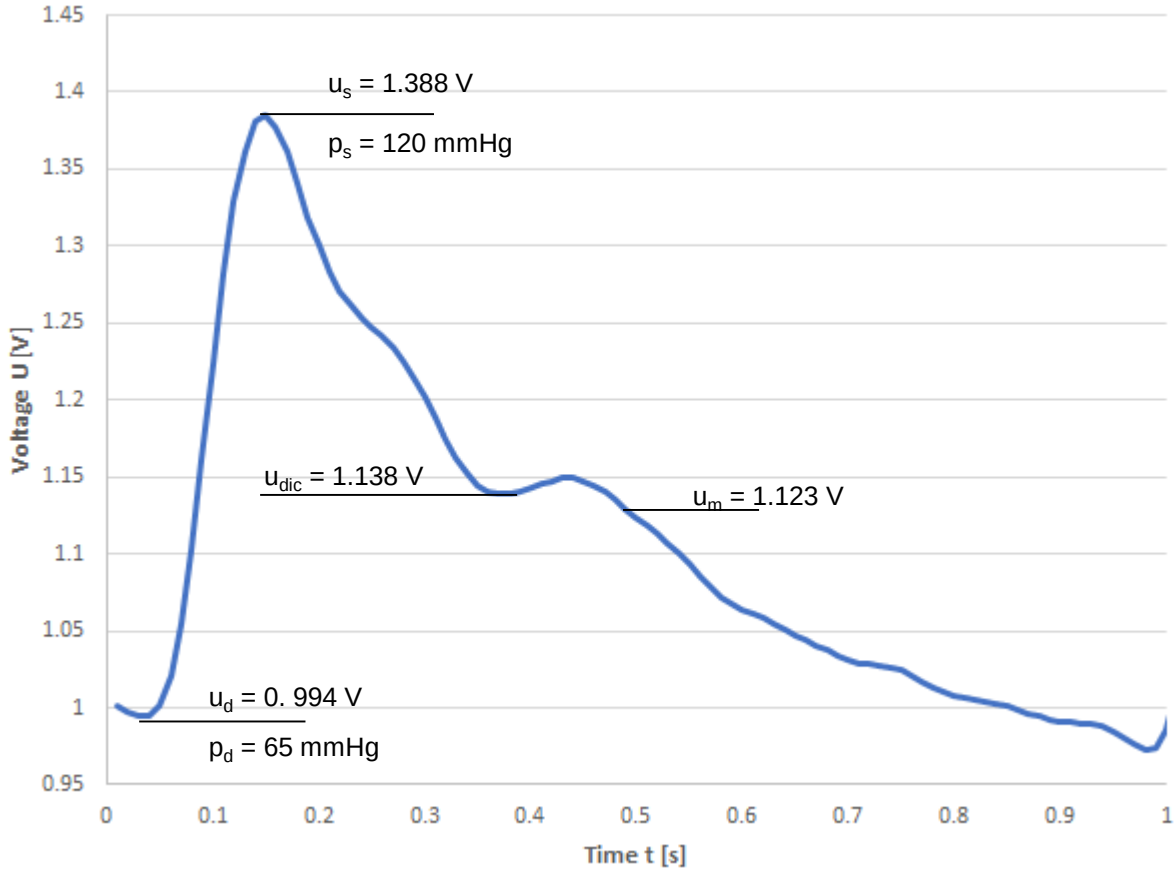
Plot 1. Blood pressure waveform measurements for patient A.

Blood pressure waveform



Plot 2. Single blood pressure reading.

Blood pressure waveform



Plot 3. Characteristic points of waveform

Methods of callibration

- Standard method based on paralel measurement of systolic and diastolic pressure with use of reference (sphygmomanometer) and new device.

- Second method based on substitution of experimentally proven coefficient b with its analitical equivalent from mathematical model of described sensor.

Standard method

Determining coefficients of linear equation:

$$p = a + b \times u$$

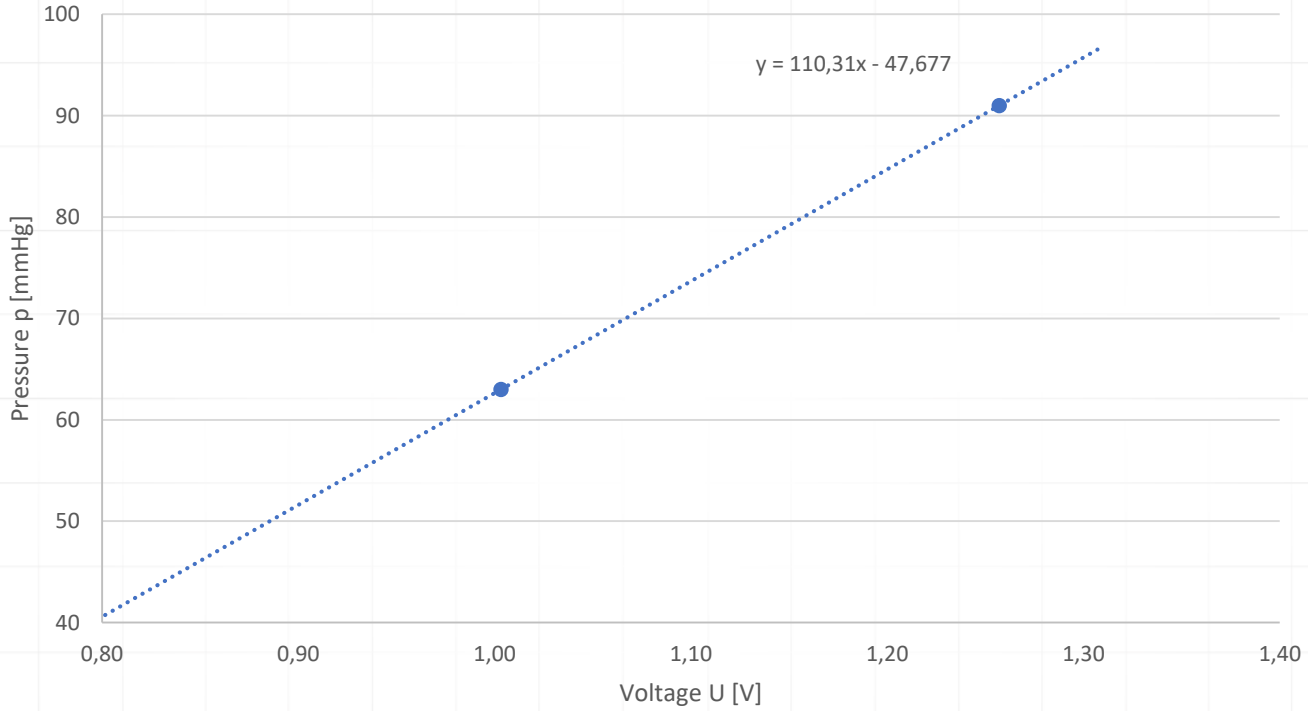
Coefficient a:

$$a = p_s - \frac{p_s - p_d}{u_s - u_d} \times u_s$$

Coefficient b:

$$b = \frac{p_s - p_d}{u_s - u_d}$$

Standard method



Plot 4. Finding corelation between measurement from sphygmomanometer and new device

Second method

Calibration equation of second method:

$$p = p_m + b \times (u - u_m)$$

Coefficient b equation:

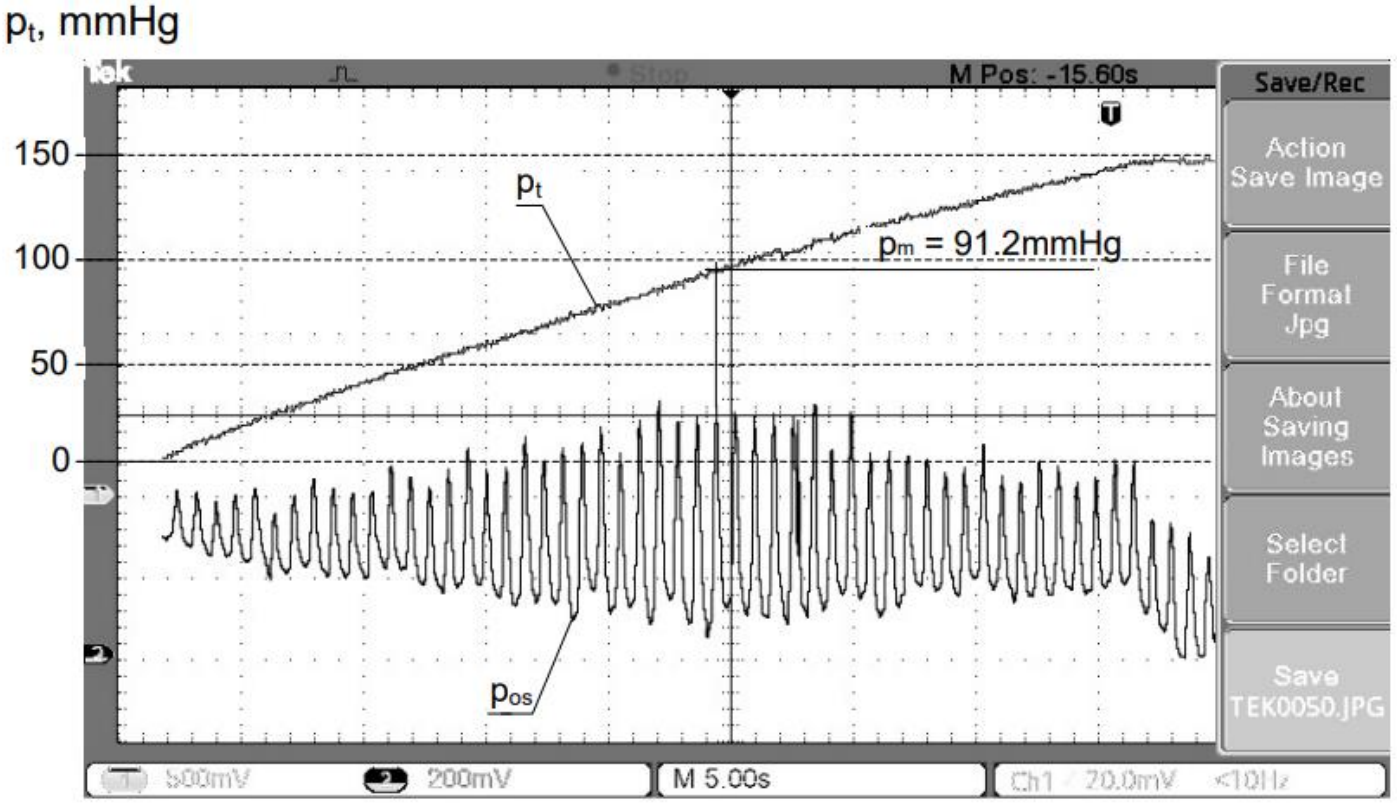
$$b = \frac{1}{k_1 \times k_2}$$

k factors or sensor and transducer:

$$k_1 = \frac{A_1}{A_2} \qquad k_2 = \frac{u}{\Delta p_2}$$

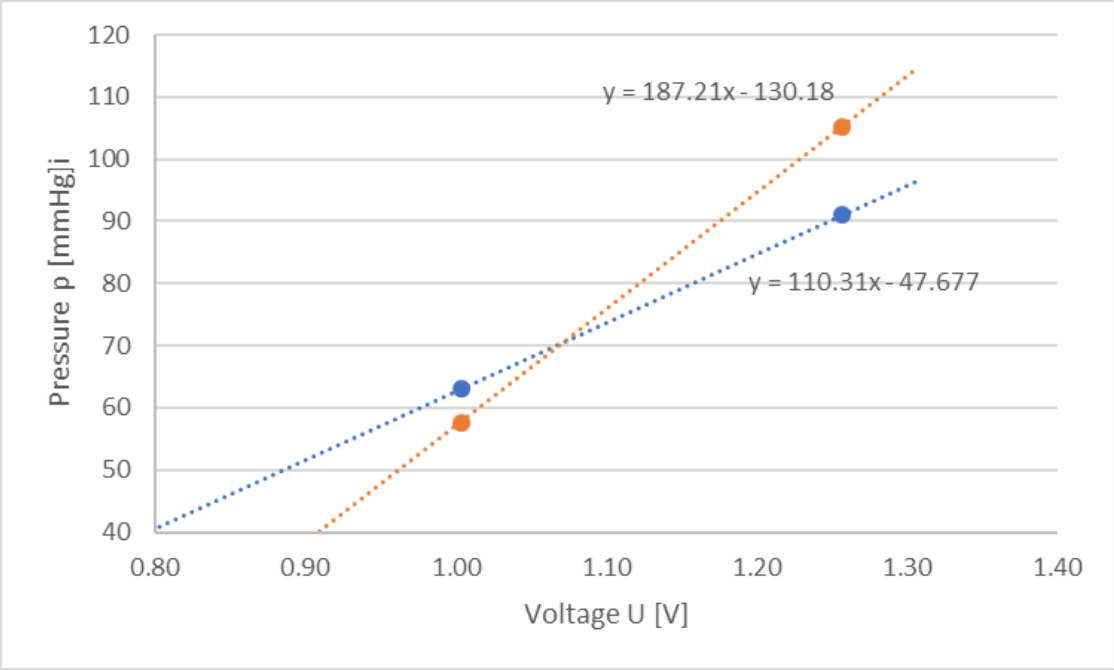
Second method

Determining medium pressure p_m



Value of p_m is determined by the peak with highest amplitude – when testing pressure equals p_m.

Second method



Plot 5. Corelation comparison of two methods.

Method comparison

Standard method

- $p = -52 + 110 \times u$
- $\Delta x = 0.15$
- A lot of data has to be processed to extract valid b coefficient.

Second method

- $p = p_m + 105 \times (u - u_m)$
- $\Delta x = 0.12$
- Easy to aquire b coefficient and $p_{m.}$

Thank you for your kind attention