Project: Digital Sphygmomanometer

Arterial pressure is most commonly measured via a sphygmomanometer, which historically used the height of a column of mercury to reflect the circulating pressure. Blood pressure values are generally reported in millimeter of ercury (mmHg), though aneroid and electronic devices do not contain mercury. More information in the link… https://en.wikipedia.org/wiki/Blood_pressure

Automatically oscillometry is performed using a standard arm cuff together with an in-line pressure sensor. The recorded cuff pressure is high-pass-filtered above 0,5 Hz to observe the pulsatile oscillations as the cuff slowly deflates (Fig. 1). It has been determined only recently that the maximum oscillations actually correspond with cuff pressure equal to mean arterial pressure (MAP). Systolic pressure (Ps) is located at the point where the oscillations are a fixed percentage of the maximum oscillations In comparison with the intra-arterial pressure recordings, the systolic detection ratio is Ps/MAP = 0.55. Similarly, the diastolic pressure (Pd) can be found as a fixed percentage of the maximum oscillations, as Pd/MAP = 0.85.

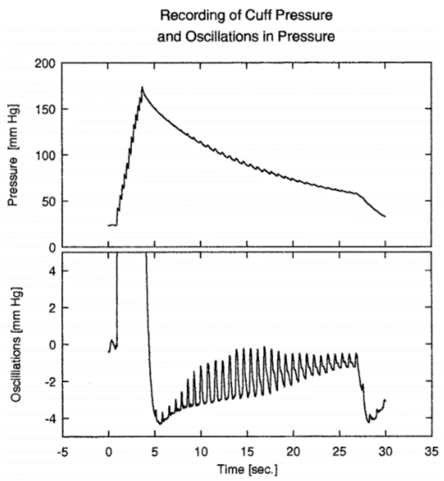

Figure 1: Sample recording of cuff pressure during oscillometric blood pressure measurement. Bottom panel shows oscillations in cuff pressure obtained by high pass filtering above 1/2 Hz.

Systolic pressure = cuff pressure when the oscillation amplitude is 55% of the maximum amplitude
Diastolic pressure = cuff pressure when the oscillation amplitude is 85% of the maximum amplitude

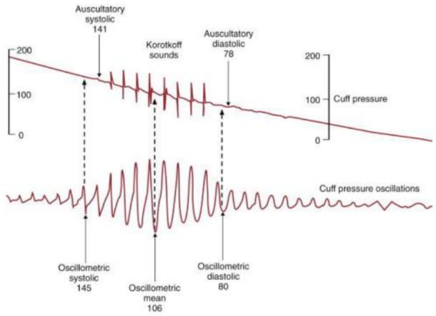

Figure 2: The pressure at which the oscillations have their maximum amplitude is the Mean Arterial Pressure (MAP).

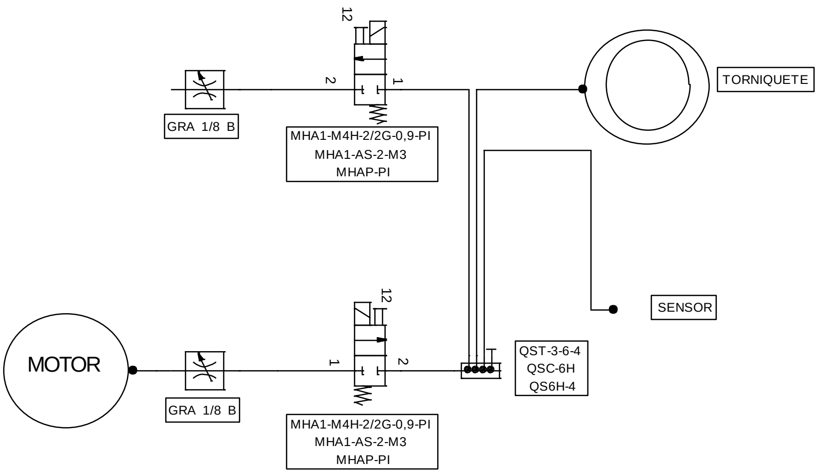

Fig. 3: Simplified designer of the arterial pressure digital system.

Project: Characterization and automatization of the digital arterial pressure prototipe.

Part 1- Characterization of the system

1 – Investigate how the system working and evaluate the performance of each element (sensor, pump, electromagnetic key) individually.

2 – Characterize the pressure sensor (calibration factor, resolution, linearity, etc).

a) Use a calibrate pressure sensor to evaluate element pressure sensor. Using a manual air pump, applied a pressure in the range of 0 - 250 mmHg.
b) Using a instrumental 744 Op amp, building a instrumental amplifier to obtain 5 volts in the output of the Amplifier when the pressure on sensor was 300 mmHg.

c) Measure the pressure in the calibrate transducer and simultaneously with the output voltage of the sensor. Using pressure step of 250 mmHG, repeat the procedure 5 times;
d) Plot the curve output sensor (Volts) versus Pressure (mmHg) and obtain the calibration factor;
e) Estimate the resolution of the transducer;

3 – Using a 5 volts from the DC source, open and close the electromagnetic key.

4- Shorting the pump with the electromagnetic key and fill and empty the sphygmomanometer air bag;

Part 2- Start the construction of the software of automation in the Labview environment;

1: Using labview environment,

a) Building a VI to acquire the output signal from the instrumental amplifier using the differential configuration of the USB 6009 board (AI0 – AI3);
b) Using calibrate factor, calculating and shows the pressure in mmHG;
c) Using the pressure information, create a condition to write a voltage in the output pin of the USB 6009 board. 0 Volts if the pressure is less than 50 mmHg and 5 volts of the pressure is biggest than 300 mmHg;
d) When the system is working properly, fix the air bag on the arm of the volunteer and repeat 5 measurement;

Note1: For this test, use the air bag fixed on cylinder (arm simulate);

Note 2: Test your software of automation using a generator and oscilloscope before test in the arterial pressure system;

Technical information

a) Inflate the air bag with maximum pressure of 250 mmHg;
b) Deflation the air bag with a rate of 2 mmHg/s;
c) Register the pressure signal during the inflation and deflation;
d) Colocar o manguito em um voluntário;

Part 3- Arterial signal pressure processing

During the deflation a typical oscillating sound appear in the systolic pressure and disappear in the diastolic pressure. In this range of pressure the output signal is modulating by this oscillation. To remove this oscillating signal from the arterial pressure register, you need:

a) Subtracting the linear fitting from signal;

b) Apply a low frequency filter;

c) Using a peak detector;

d) Calculate the amplitude of half-width;

Note 1: See the paper of reference.

A report with details of the arterial pressure system (instruction, methodology and results) must be delivered in the data indicated by professor;

Materials of KIT

Code	QTD	DESCRIPTION	TYPE
151215	2	Válvula reguladora de vazão unidirecional	GR-1/8-B
153012	4	Conexão rápida	QS-1/8-4-I
153314	4	Conexão rápida	QSM-M3-4-I
197042	2	Válvula solenoide	MHA1-M4H-2/2G-0,9-PI
197187	2	Base de conexão simples	MHA1-AS-2-M3
197260	2	Base de conexão	MHAP-PI
153203	1	Distribuidor múltiplo	QST3-6-4
153268	1	Bujão (Manguito adulto)	QSC-6H
153041	1	União rápida	QS-6H-4
159662	2	Tubo	PUN 4

MPXM2102AS	1	SENSOR PRESSÃO 40MV	
	1	Bomba de compressão 3V	

Bibliografia

1 - Wolf W. von Maltzahn. University of Texas at Arlington- Medical Instruments and Devices. 2000.