Testování a vývoj taktilních senzorů
Testing and Development Tactile Sensors

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Abstrakt:

Tento příspěvek se zabývá problematikou taktilních senzorů. Jsou zde uvedeny některé příklady taktilních senzorů. V další části je testování FSR snímače a Plantografu a jsou zde uvedeny různé charakteristiky, které nám popisují chování taktilních snímačů. V závěru je uvedeno prototyp nového snímače, který je ve vývojové a testovací fázi..

Abstract:

This article is about tactile sensors. We can see some examples of their construction. In next part is testing FSR sensors and Plantograf. Here are described some testing characteristics which can helps us for better description behavior of tactile sensors. At the end is introduction prototype of the new tactile sensors which is in development and testing period.

Klíčová slova:

Taktilní Senzory, FSR Senzor, Plantograf, Testování, Hmat, Charakteristiky Taktilních Senzorů, Vizualizace Taktilních Senzorů.

Keywords:

Tactile Sensors, FSR sensor, Plantograf, Testing, Human Touch, Tactile Sensors Characteristics, Sensor Imaging.

1. Introduction

Tactile transducers and tactile sensor are devices which measures the parameters of a contact between the sensor and an object. This article is divided into two main parts. First part reply for questions: What is tactile sensor, what is their construction, what is main using, etc. In second part is testing two tactile sensors which are on our faculty. First is FSR sensor and second is Plantograf – matrix tactile sensor, which was developed on CTU.

2. What are tactile sensors?

Tactile transducer and tactile sensor are devices which measures the parameters of a contact between the sensor and an object. They enable to get specific information, which is not possible to get by other way. They enable robots protection, subject gripping, moving, action by force, tactile imaging, etc.

Tactile transducer is usually matrix or some different tactile sensor organization. Tactile sensor is an element.
In the figure 1., we can see example of tactile sensor and in figure 2., and 3 is tactile transducer.

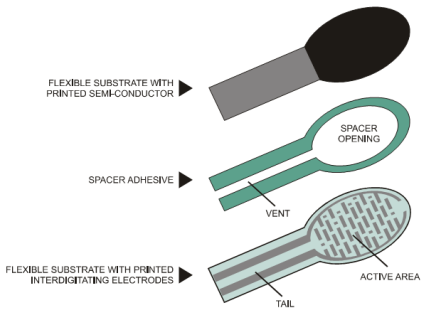

Fig. 1 FSR tactile sensor

Fig. 2 Tactile matrix sensors

Tactile se sensors can be divided by using, collecting tactile information, construction, output signal, etc.

Just for example:

Dividing by output signal

- Proportional – output has continuous character
- Discrete - output signal is logical

Dividing by construction:

- Resistive based sensors
- Mechanically based sensors
- Capacitive based sensors
- Optical Sensors
- Piezoelectric sensors
- Silicon based sensors
- …

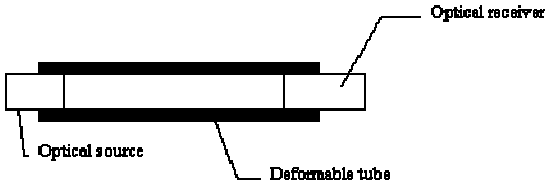

Fig. 3 Optical sensor

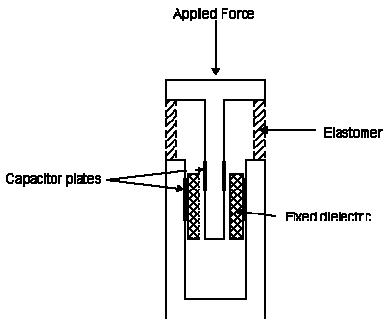

Fig. 5 Capacitive sensor

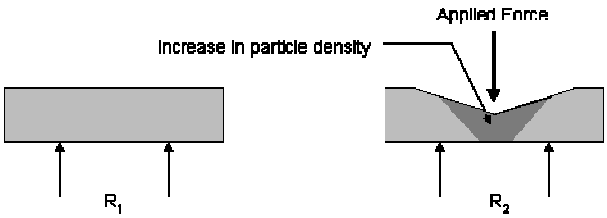

Fig. 4 Resistive sensor

Dividing by collecting tactile information:

- Primary – tactile sensor, which goes to direct contact to gripped subject
- Secondary – tactile sensor, which captures tactile information vicariously

3. Testing FSR sensor and Plantograf

FSR sensor is in figure 1. Parameters of FSR sensor:

- Active area 12,7mm
- Device thickness 0,46mm
- Force sensitivity range from 10g to 10Kg
- Stand off resistance >1MΩ
- Temperature range from –30° to +70°C

Catalog characteristic is on figure 6.

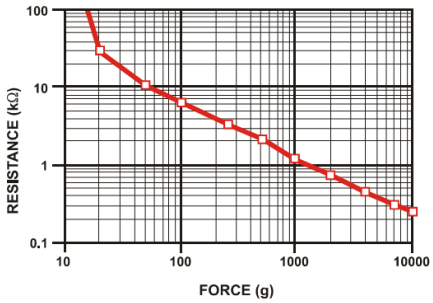

Fig. 6 Resistance vs force

Next testing sensor is matrix sensor Plantograf which was developed by cooperation of Faculty of Mechanical Engineering CTU in Prague, Faculty of Electrical Engineering CTU in Prague, Faculty of Physical Education, Sport Charles University and Rehabilitation Clinic of CU Hospital in Vinohrady in Prague. This matrix tactile sensor is in figure 7.

Technical parameters:

Patient mass	to 120 kg
Rated pressure range	5 - 80 kPa
Permissible overload	1.4 Mpa
Transducer active area	400 x 300 mm
Transducer dimension	750 x 650 mm
Sensors number	7500 pcs
Sensor dimension	3x3 mm
Transducer supply voltages	+ 5V + 12 V
Transducer analogue output	to 1V
Digital output	256 levels
Snap frequency	300 Hz
Snaps number	60 snaps / 200 ms

Fig. 7 Plantograf

First was test FSR sensor. We tried to use pressure tank which is on figure 8. This measuring system consists of pressure tank, compressor and pressure gauge. Pressure force is calculated by pressure in pressure tank and area of tactile sensor. Finally this measuring system wasn't help full for us because calculate values wasn't similar like catalog values. This is caused by unfit membrane which is in pressure tank.

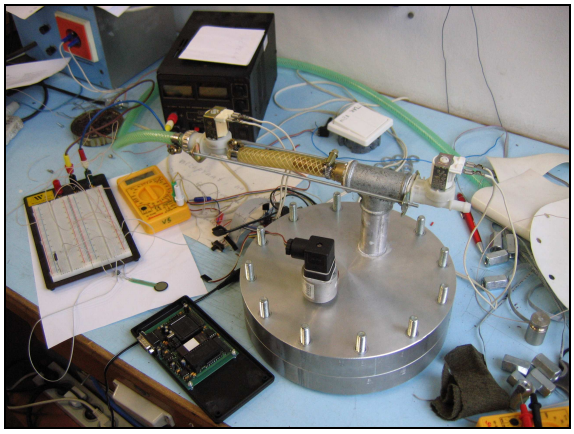

Fig. 8 Pressure tank

Next testing was by lever system and measuring station Agilent Agilent 34970A with measuring card Agilent 34901a. Connection of tactile sensor is in figure 9.

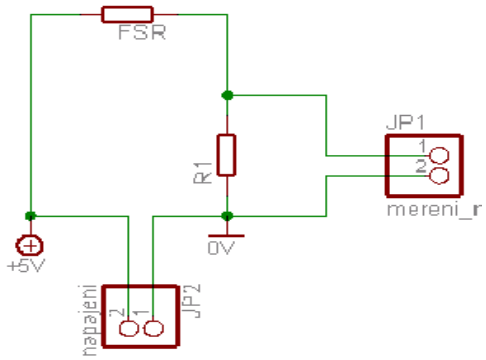

Fig. 9 Connection of tactile sensor

FSR sensor was connected by logger and added under lever system. Then we did cycles of loading and unloading. Characteristic you can see in figure 10. Average values are in figure 11.

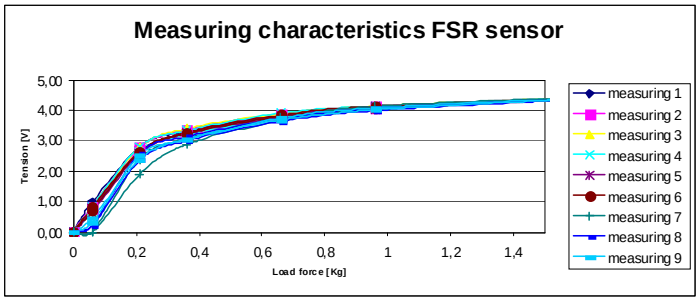

Fig. 10 Measuring characteristics FSR sensor

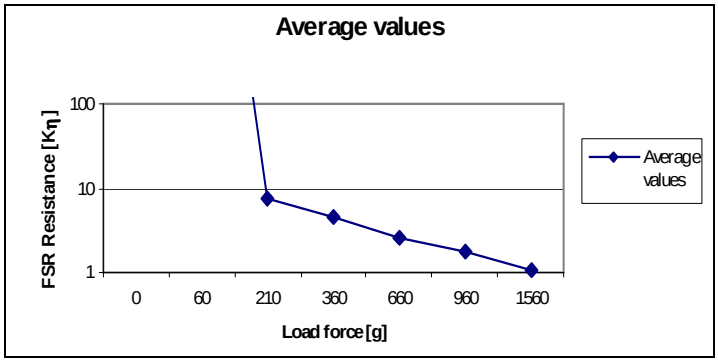

Fig. 11 Average values

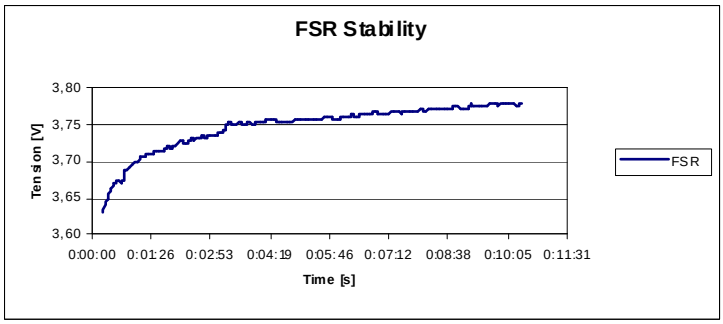

Fig. 12 Stability of FSR

In the figure 12., is stability of FSR sensor, we can see that the sensor after time period has trend to increase tension so that's mean that the resistance is decreasing.

Next testing was with Plantograf. On matrix tactile sensor was put an object (shape triangle and circle by dimensions from 1 to 250 cm^2). Than was cycles loading and unloading and unloading and loading. Results of this testing is displayed in the figure 13. The axes y means object area and axes x means relative value of pressure force expressed as 256 colors lever.

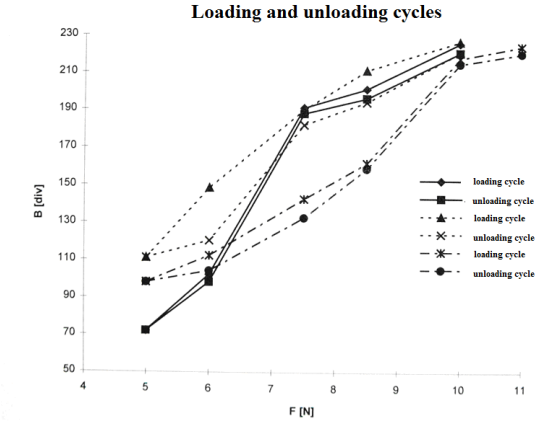

Fig. 13 Loading and unloading cycles

Statics testing with different objects is in figure 14 and 15.

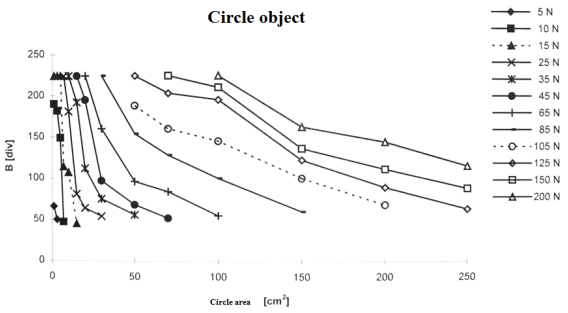

Fig. 14 Characteristic of constant force, circle object

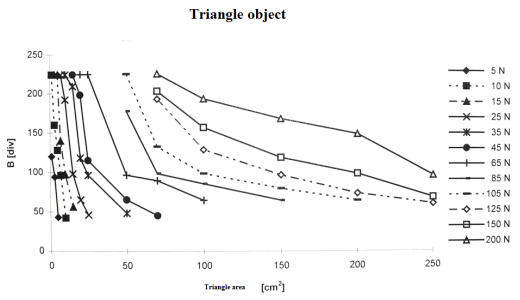

Fig. 15 Characteristic of constant force, triangle object

4. Future of tactile measuring systems

In this time we are developing new version of electronics of Plantograf. New evaluation electronics is based on programmable gate array FPGA Xilinx Spartan. This construction will

minimize tactile sensor size. Prototype has size 160 x 55 mm. This prototype is faster than old Plantograf. Estimated scanning time is about 5000 snaps/s. Communication will be established by USB. For high-speed scanning will be use high speed memory card. Prototype is in figure 16.

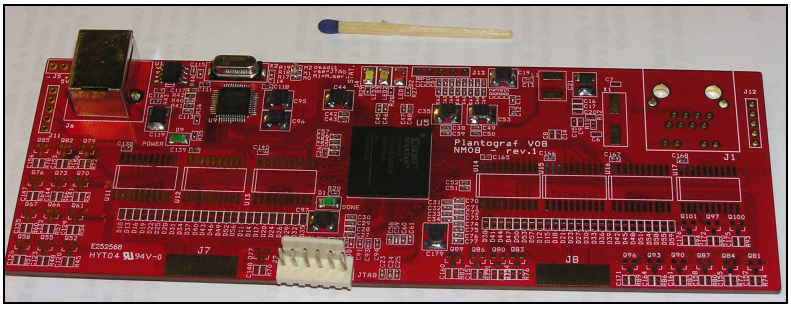

Fig. 16 Tactile sensors prototype electronic

5. Conclusion

This article shows some example of tactile sensors and tactile transducers. Main part is about testing FSR tactile sensor and Plantograf. This testing is very used for us, because all tactile sensors are just only relative tactile sensors and it is very difficult to make an calibration to make absolute tactile measuring system. All these information help us for better description characteristic tactile sensors and help us with calibration. Calibration is the main problem, which we want to solve.

Reference:

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