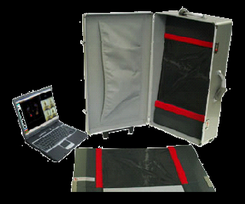
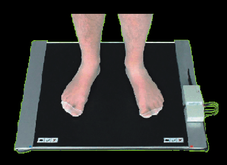
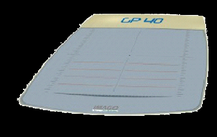




Istituto Superiore di Sanità







TECHNICAL ASSESSMENT IN BAROPODOMETRY: A WORK IN PROGRESS.

C. Giacomozzi

Dept. of Technology and Health, Istituto Superiore di Sanità, Rome, Italy

INTRODUCTION

The growing use of pedobarographic systems – in the following identified as PMDs - as a diagnostic tool in hospitals and private clinics urgently calls for a scientific study on the quality and reliability of the existing systems available on the market.

In 2006 ISS approved a 2-years scientific project aimed at setting up, validating and using dedicated testing methods and instruments for PMD technical assessment. Official letters were sent to the Companies to invite them to co-operate to the study.

Work is still in progress. The methodology and some preliminary results are reported here below.

MATERIALS AND METHODS

The testing protocol focuses on the physics of measuring static and dynamic local pressure in distributed fields, in order to assess the accuracy of local pressure and force. Attention is also paid to hysteresis, temperature influence, crosstalk, repeatability and other physical parameters. Measurements are conducted on the final product as a whole, thus including hardware and software components as they are delivered from the factory (i.e. sensor matrix, electronics, acquisition/conversion tools, calibrations, etc). Fig. 1 shows the purposely designed testing devices.

Testing protocol

Local pressures/forces are measured in 5 random subareas of the platform. Each subarea (7.03cm^2) undergoes the following tests (please refer to Fig. 1):

-steps of static pressure (A): pressure is applied through an on-off valve from 0 to 600kPa and down to 0, step 50kPa, each step lasting 5s. The area is completely offloaded after each step;

-sinusoidal pressure (A): the area is continuously loaded/unloaded in the range 0-500kPa, frequency 0.75Hz;

-creep (device A): the area is loaded (350kPa) for 60s;

-COP estimation (B): an established force is applied through the three supports of the graduated table for 5s; the measurement is repeated 6 times with angular steps of 20° .

Overall pressure distribution is assessed by using the press device (Fig.1C): successive steps of pressure may be uniformly applied from 0 to 1200kPa and down to 0 (the upper limit depending on the PMD technical specifications).

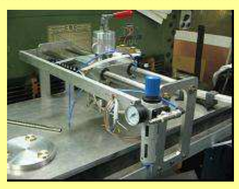


Figure 1. Testing devices

A. Pneumatic testing device with force and pressure controls. Pressure may be applied in the range 0-700kPa under static and dynamic conditions over a 7.03cm² area. The pressure transducer has high linearity, and low relative error (<1%).

B. Special tool to be used in conjunction with A. It allows to apply established vertical forces through 3 pins (angular distance 120°).

C. Custom pneumatic bladder based pressure tester/calibrator. Pressure may be uniformly applied over wide areas in the range 0-1200kPa.

RESULTS

Work is still in progress. Some interesting preliminary results are here reported for the three platforms which have been tested up to now. Results from the central area are reported for local pressure assessment. Alphabetic order is respected, based on the name of the Companies.

COMPANIES AGREEMENT

DIAGNOSTIC SUPPORT, Italy (resistive PMD) →	DID NOT RESPOND
IMAGO ORTESI (MEDICAPTEURS), Italy (resistive PMD) →	DECIDED NOT TO PARTICIPATE
LORAN, Italy (1 resistive and 1 capacitive PMD) →	AGREED – TEST SCHEDULE: END OF AUGUST 2008
NOVEL, Germany (capacitive PMD) →	**PARTICIPATED – TESTED 2006**
RSSCAN, Belgium (resistive PMD) →	**DID NOT RESPOND. TEST ON PRODUCT FROM THE MARKET (2008)**
TEKSCAN, USA (resistive PMD) →	**DECIDED NOT TO PARTICIPATE. – TEST ON PRODUCT FROM THE MARKET (2007)**
AM3, France (capacitive PMD) →	AGREED – TEST SCHEDULE: END OF AUGUST 2008

USER CALIBRATION

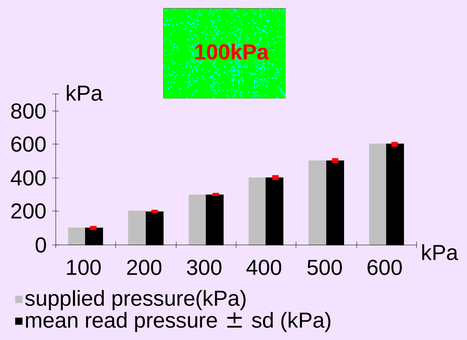
NOVEL. User calibration is not requested.

RSSCAN. User calibration is mandatory. When the PMD is used standalone – not in conjunction with a well calibrated force plate –its calibration is strictly dependent on the correctness of the input body mass.

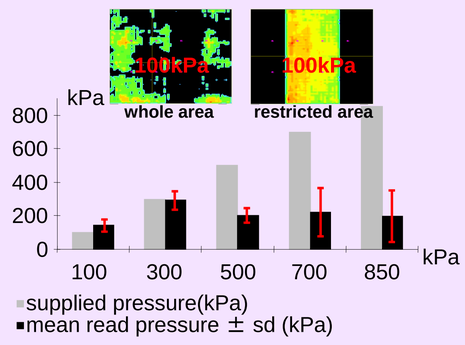
TEKSCAN. User calibration is mandatory. The standard suggested method was not sufficient to obtain correct results. A special calibration procedure was necessary, which is only available with the Research Software option.

OVERALL PRESSURE DISTRIBUTION (test device: Fig. 1C)

NOVEL(EMED-X; 5568 sensors)

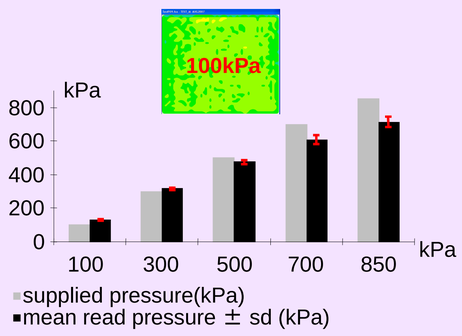


RSSCAN (Footscan; 1764 sensors*)

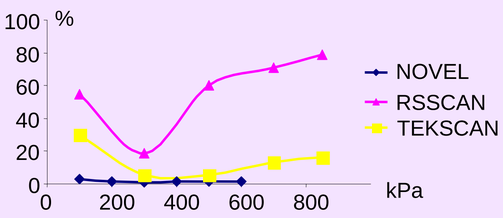


*the PMD did not allow a correct pressing of the whole surface. The test was performed over a restricted area

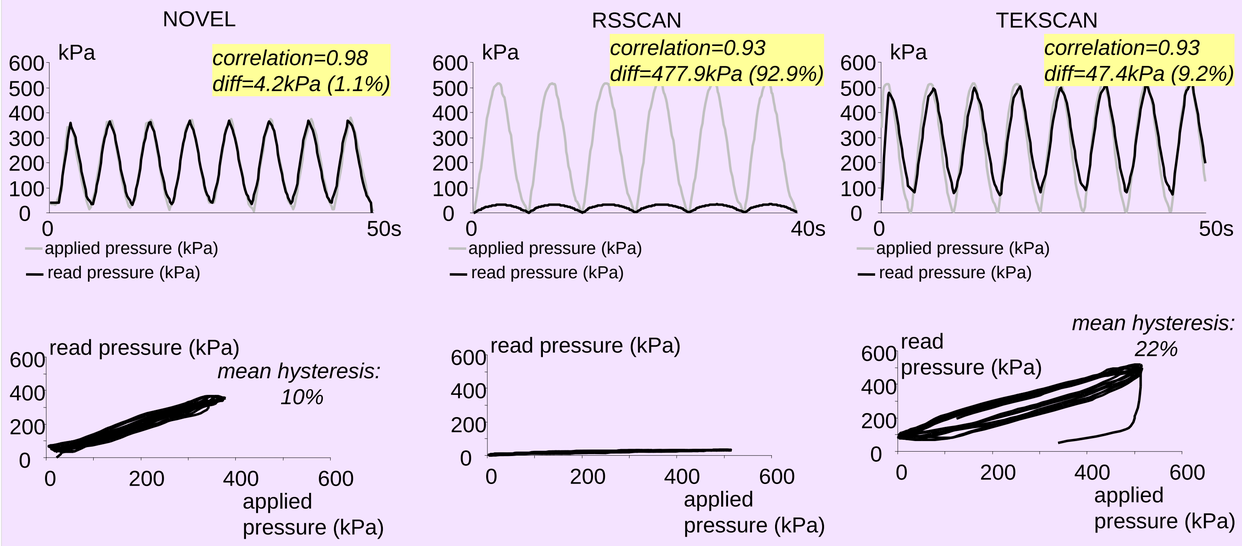
TEKSCAN (Matscan; 2288 sensors)



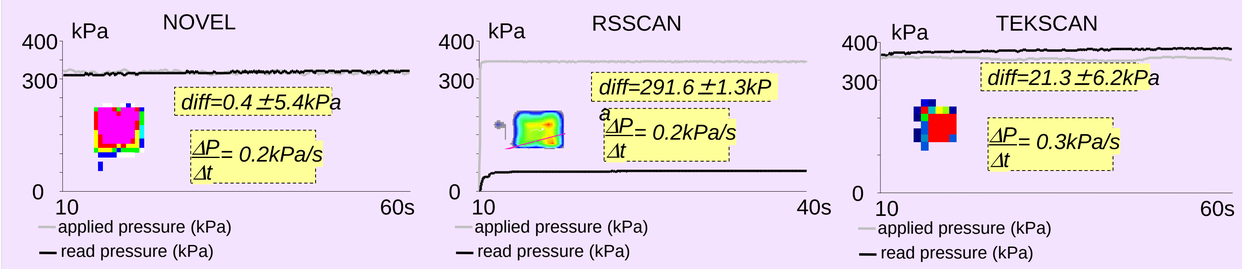
RMSE (% of applied pressure)



SINUSOIDAL LOADING (test device: Fig. 1A)

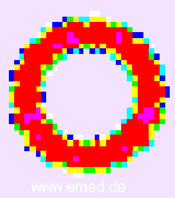


CREEP (test device: Fig. 1A)



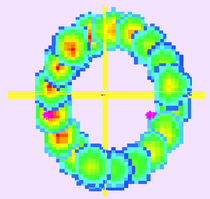
COP ASSESSMENT (test device: Fig.1B)

NOVEL



RMSE = 0.02cm (x)
0.07cm (y)

RSSCAN



RMSE = NA

TEKSCAN

RMSE = 0.19 cm(x)
0.13cm (y)

CONCLUSIONS

Currently, only 34% of the Italian Movement Analysis Labs uses PMDs while more than 70% relies on dynamometric platforms (www.siamoc.it, 2005 survey). Most of them still consider pressure parameters from a qualitatively point of view only. We believe that the present technical assessment may help in clarifying the potentialities of the available PMDs and in delivering guidelines to perform accurate quantitative baropodometry.