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# Influence of local pressure on the oscillations of cutaneous blood flow

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## Introduction

Vascular reactivity has been used in a number of studies for characterizing mechanisms involved in the regulation of skin blood flow and detecting functional abnormalities associated with the development of pathologies, as well as evaluating the effectiveness of treatment.

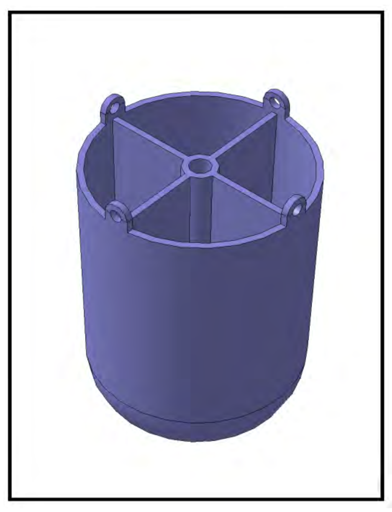
## The aim of research

The aim of this research was to identify patterns of the relationship between the oscillating components of blood flow registered by the LDF method under different levels of pressure applied to the skin.

## Experimental method and equipment

**Laser Doppler flowmetry "LAKK-02"**

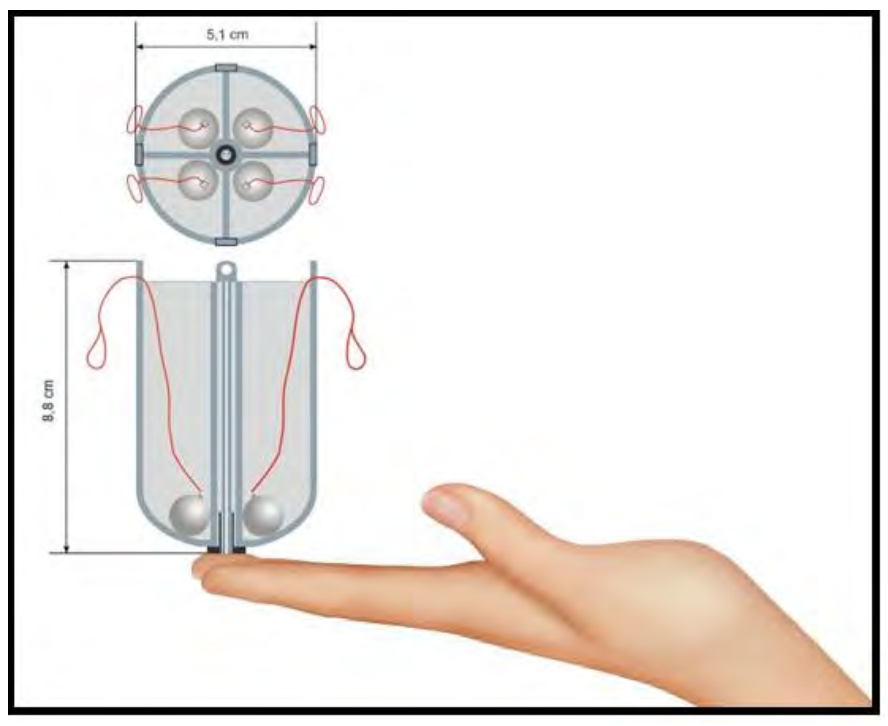
**Special tooling designed and 3D printed**



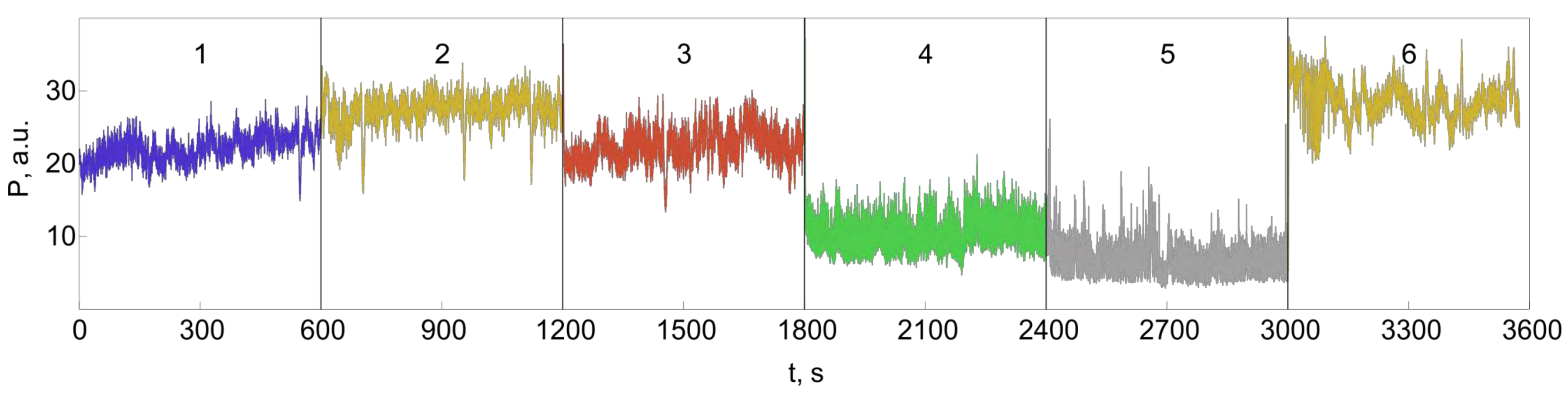
The measurements were carried out by the laser Doppler flowmeter LAKK-02 (SPE LAZMA Ltd., Russia) with laser probing radiation of 1064 nm. The calibrated pressure was applied to skin by use of the special 3D-printed tooling.

## The Concept

Six young volunteers (three males and three females) 20±2 years old were included in this preliminary study. The measurements have been conducted on a skin pad (palmar surface) of the right middle finger of healthy volunteers. The developed protocol included six sequential records of the blood perfusion at pressure within the range of 0 to 200 mmHg with unloading at the last stage.




**Scheme of the experimental setup**

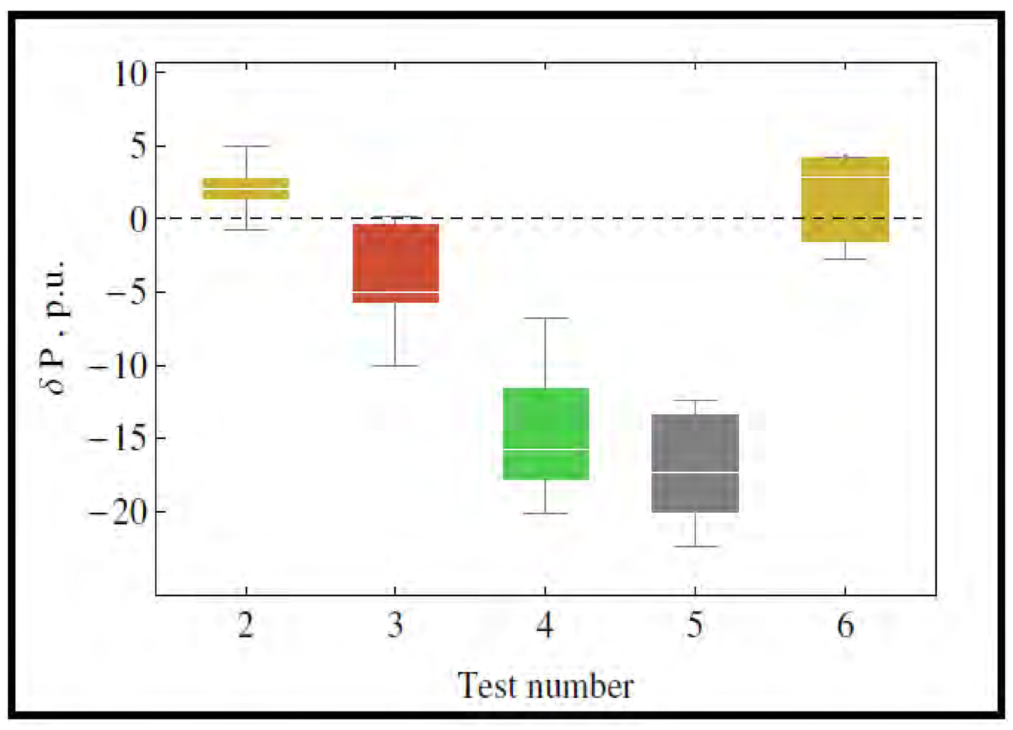



**Typical example of the LDF sample**

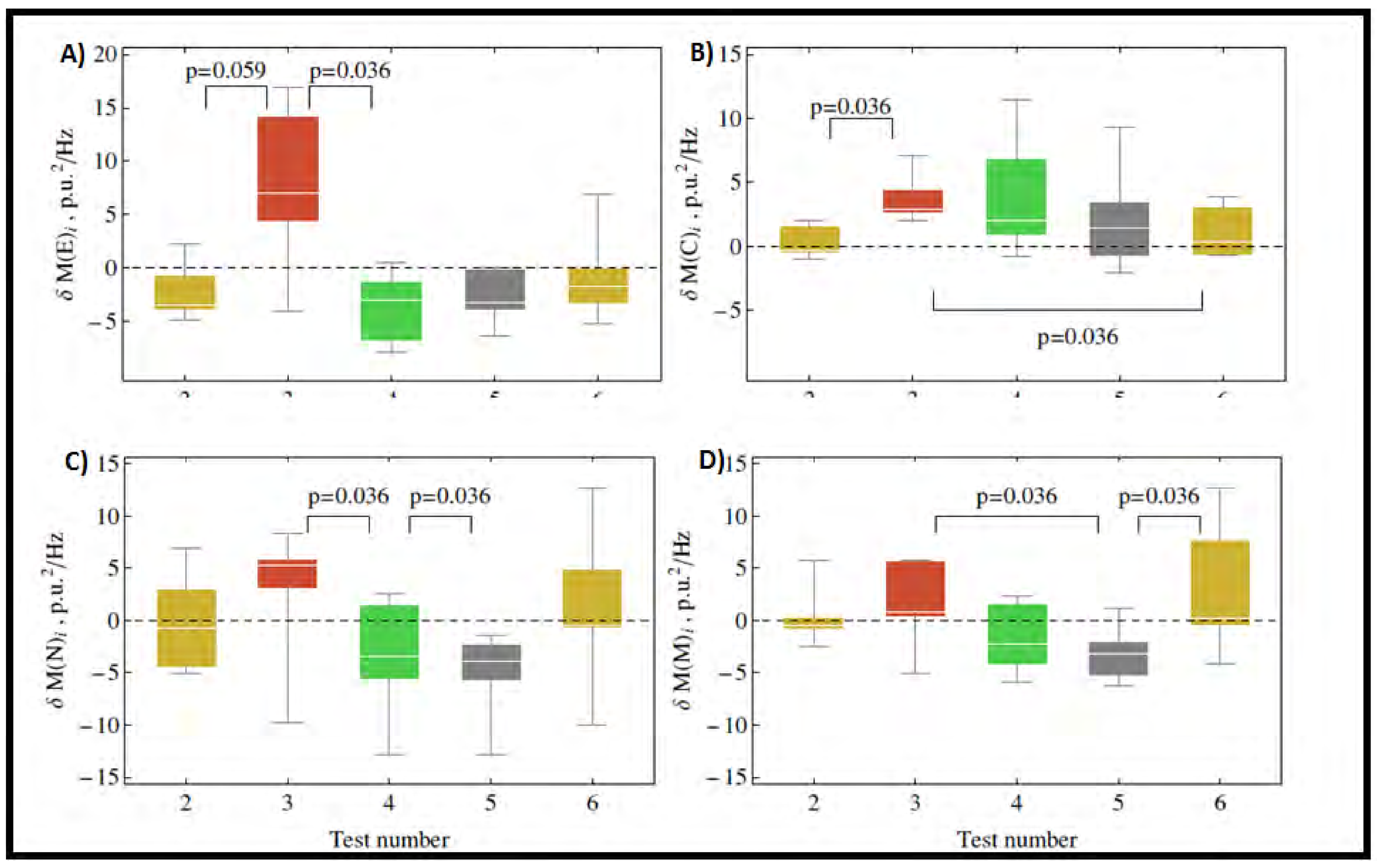
The LDF-records were subjected to wavelet analysis using the algorithm based on the Morlet wavelet core function. The protocol was repeated five times for each volunteer. The pressure influence on the perfusion and the redistribution of the power spectral densities of LDF flow in each stage of the protocol was been evaluated.

## Results and Discussion

The low pressure induces vasodilation, and further loading induces constriction. Note that a decrease in perfusion is attributed to the external impact but not to the internal physiological mechanisms of constriction. The increase in the skin blood flow observed in the second load period is, probably, associated with pressure induced vasodilation (PIV).




**Group-averaged variation in the mean values of perfusion caused by local loading**




**Variation of mean energy of associated A)Endothelial; B)Cardiac; C)Neurogenic; D)Myogenic**

It has been found that the endothelium pulsations during test 2 are weaker than the same oscillations in a basal state. The dynamics of cardiac associated pulsations is slightly different. In contrast to the base level and weak loading , an increase of is observed in all samples during test 3.The evolution of myogenic and neurogenic associated oscillations is very similar. Moderate loading (90 mmHg) leads to an increase of amplitude of pulsations, which decreases and becomes lower than in basal state during tests 4 and 5.

## Conclusion

The obtained results led us to conclude that the LDF signal in mean and oscillation components varies considerably. Low pressure leads to PIV, so if a LDF diagnostic device uses a probe which weakly compresses the skin, the measured skin perfusion will be distorted and presumably overestimated. This should be taken into account when developing wearable LDF devices.

## Acknowledgment

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