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PILOT STUDIES OF THE SYNCHRONIZATION IN SKIN BLOOD FLOW OSCILLATIONS IN CONTRALATERAL LIMBS

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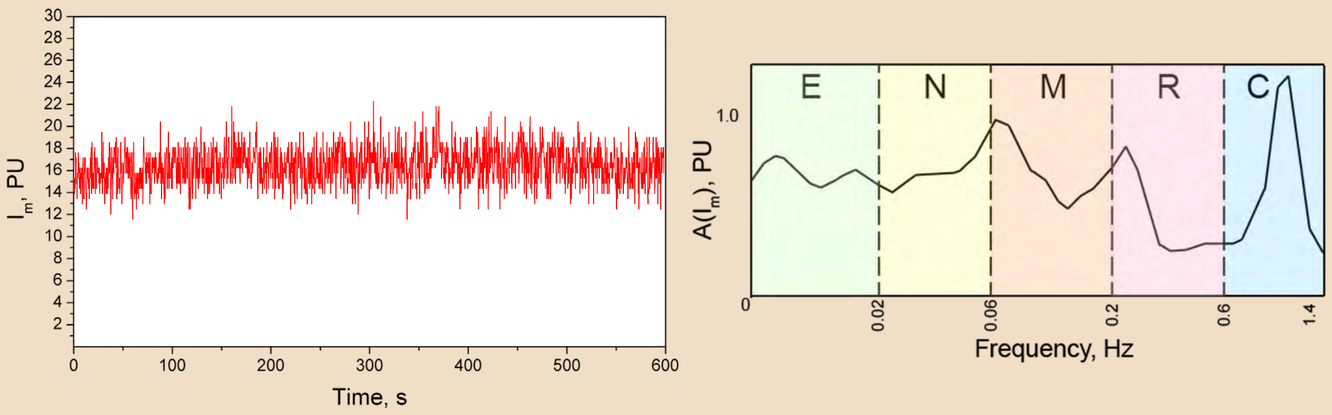
INTRODUCTION

The study of blood microcirculation provides valuable diagnostic information and can be of particular interest in the evaluation of the severity and nature of different diseases. Laser Doppler flowmetry (LDF) is one of the most informative optical non-invasive methods for diagnosing the functional state of skin microcirculation. LDF allows us to evaluate the level of blood flow as well as the oscillatory processes in microvessels. There are several frequency ranges characterizing the contribution of various factors to the LDF signal: endothelial (0.0095-0.02 Hz), neurogenic (0.02-0.05 Hz), myogenic (0.05-0.15 Hz), respiratory (0.2-0.45 Hz) and cardiac (0.45-1.6 Hz).

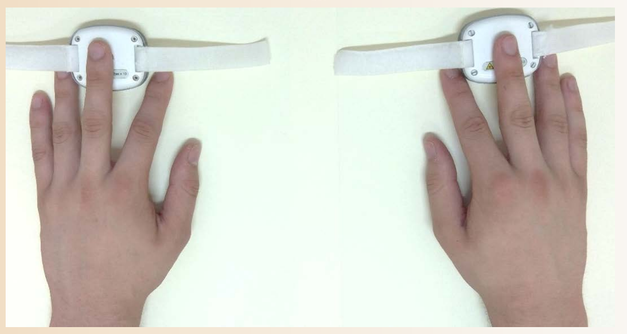
The purpose of this work was to investigate the synchronization of blood perfusion signal from contralateral limbs in different age groups.



A typical example of blood perfusion record by LDF and wavelet analysis of the record

EXPERIMENTAL METHOD

The experimental studies were carried out using four wearable laser Doppler flowmetry devices (LAZMA PF, SPE LAZMA, Moscow) for blood microcirculation analysis, implementing identical channels for blood perfusion registration. Roszdravnadzor Resolution №660/2018.



Location of the sensors

Studies were conducted in the sitting position; hands were placed on the table at the heart level. The blood perfusion was registered for 10 min with the location of sensors on the palmar surface of the middle fingers distal phalanxes.

Groups of volunteers		
	Younger group (19±0.8 years)	Older group (54±9 years)
The number of volunteers	18	18

RESULTS AND DISCUSSION

The results of the study identified the higher perfusion level in group of older volunteers comparing to younger volunteers. Statistically significant differences between the two groups were found in amplitudes of endothelial and myogenic oscillations.

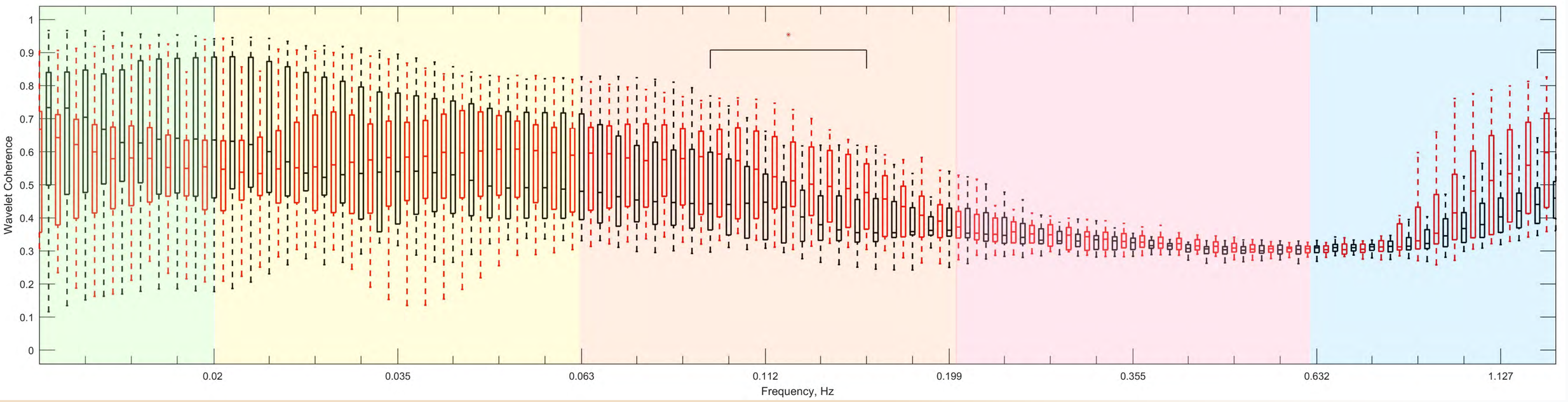
The results of the wavelet coherence analysis of the data revealed that the myogenic oscillations are more synchronized in the younger group.

In order to study the synchronization of blood flow oscillations in the contralateral limbs, a wavelet coherence analysis was used. Morlet wavelet was chosen as the kernel function. The box-and-whiskers diagram was built for the demonstration of differences in coherence parameters between healthy volunteers of selected age groups.

Results of the wavelet analysis of the obtained data

Parameters	Im, PU	Ae, PU	An, PU	Am, PU	Ar, PU	Ac, PU
Younger group	14.4±4.7*	7.4±3.2*	3.5±1.5	5.6±2.6*	6.1±3.0	5.9±2.8
Older group	18.2±3.0	5.9±5.6	3.5±1.6	4.3±2.3	5.5±3.5	6.3±4.2

- *statistically significant difference between the two groups (p<0,05 according to the Mann-Whitney test)*



Analysis of wavelet coherence of blood perfusion between the middle fingers of the right and left hands of younger (red boxes) and older (black boxes) groups of volunteers

** statistically significant difference between the younger and older groups of volunteers (p<0,05 according to the Wilcoxon signed-rank test)*

CONCLUSIONS

- A statistically significant differences in the synchronization of endothelial and myogenic blood flow oscillations were found between the two age groups.
- Myogenic oscillations of blood perfusion in the younger group had a higher wavelet coherence parameter than in the older group according to Wilcoxon signed-rank test.
- The results of the study may be useful in determining the age specificity of blood microcirculation.

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