**Dynamic laser speckle imaging for fast evaluation of the antibacterial susceptibility by the disc diffusion method**

**Ilze Lihacova1,\***, Ilya Balmages1, Aigars Reinis2,3, Svjatoslavs Kistkins1,2, Dmitrijs Bliznuks4, Emilija Vija Plorina1, Alexey Lihachev1

*1Institute of Atomic Physics and Spectroscopy, University of Latvia, Riga, Latvia*

*2Pauls Stradins Clinical University Hospital, Pilsoņu 13, Riga, Latvia*

*3Riga Stradins University, Department of Biology and Microbiology, Dzirciema 16, Riga, Latvia*

*4Riga Technical University, Zunda krastmala 10, Riga, Latvia*

\* *ilze.lihacova@lu.lv*

|  |  |
| --- | --- |
| **Keywords** | phenotypic antibacterial resistance, laser speckle imaging, sub-pixel correlation analysis, image processing |
|  |  |
| **Motivation of research** | Phenotypic resistance tests e.g., disc diffusion method require 16-24 hours to obtain the results [1], while the PCR tests provide only genotypic type of antibacterial resistance. New methods are needed to assess antibacterial resistance faster than existing methods, thus providing targeted pharmacological intervention at the early stage of the disease, increasing a patient's survival chances. |
| **Aim** | The aim of study is to create laser speckle image processing algorithms capable of predicting the resulting diameter of the sterile zone by analysis of the earliest observations of the size of the sterile zone. |
| **Novelty** | Comparison of the model with experimental data obtained using the laser speckle (LS) imaging technique with sub-pixel correlation analysis will help to understand the behavior of the growth curves of the sterile zone and in the future will allow, based on short-term experiments, to predict the subsequent change in the radius of the sterile zone. |
| **Main results** | Sensitive sub-pixel correlation analysis of speckle images allows detection of small changes in bacterial activity and demonstrates radius growth curves of sterile zones around the antibiotic. The square of the radius of sterile zone is proportional to the difference between natural logarithm of the antibiotic concentration and natural logarithm of the minimum inhibitory concentration (MIC), multiplied by the diffusion coefficient and the time of antibiotic diffusion. Thus, it is possible to obtain a model of sterile zone radius growth as a function of time [2]. The ability of sub-pixel correlation analysis of LS images to find radius growth curves of sterile zones and development of theoretical model for them will be demonstrated |
| **Conclusion** | This technology provides the ability to measure changes in the sterile zone radius, significantly earlier than the disk diffusion method (recommended by the European Committee on Antimicrobial susceptibility testing (EUCAST) [3]). |
| **Acknowledgements** | This work has been supported by the European Regional Development Fund project “Rapid assessment system of antibacterial resistance for patients with secondary bacterial infections” (No. 1.1.1.1/21/A/034). |
| **References** | [1] F.C. Tenover, Encyclopedia of Microbiology, Antimicrobial Susceptibility Testing, Academic Press (2019).  [2] B. Bonev, J. Hooper, and J. Parisot, J. Antimicrob. Chemother. 61, 1295–1301 (2008).  [3] EUCAST 2022, available online: https://www.eucast.org/clinical\_breakpoints/. |

|  |  |
| --- | --- |
| Topic | *Biosensing and Biosignal Analysis and Processing* |
| Preferable type of presentation | Oral **Poster** |