

Piotr Przymus

FACULTY OF MATHEMATICS AND COMPUTER SCIENCE, NICOLAUS COPERNICUS UNIVERSITY, CHOPINA 12/18, 87-100 TORUŃ, POLAND

e-mail: eror@mat.umk.pl,

Krzysztof Rykaczewski

FACULTY OF MATHEMATICS AND COMPUTER SCIENCE, NICOLAUS COPERNICUS UNIVERSITY, CHOPINA 12/18, 87-100 TORUŃ, POLAND

e-mail: mozgun@mat.umk.pl

**Extraction and detection of freshwater mussels behaviours,
using wavelets and kernel methods**

Some species of mussels are well-known bioindicators and may be used to create a Biological Early Warning System. Such systems use long-term observations of mussels activity for monitoring purposes. Yet, many of these systems are based on statistical methods and do not use all the potential that stays behind the data derived from the observations. In the paper we propose an algorithm based on wavelets and kernel methods to detect behaviour events in the collected data. It consists of raw data obtaining, pre-processing and feature extraction. In the pre-processing step, a high-pass filters and white de-noising were used. During the recognition of events wavelet packet was applied and then the data was averaged by kernel method. Our motivation was to highlight the multiple time scale properties and to exam the possible connections between behaviour of zebra mussel and water state. Results show that pollution could be characterized by the biological signal generated by *Dreissena polymorpha*. Our study also showed that wavelet transforms could be powerful methods for probing the dynamical relationship between the signal and environment variability.

REFERENCES

- [asi00] J. T. Białasiewicz. *Wavelets and Approximations (in polish "Falki i aproksymacje")*. Wydawnictwo Naukowo Techniczne, Warszawa, 2000.
- [Bis06] Ch. M. Bishop. *Pattern Recognition and Machine Learning*. Springer, 2006.
- [Bor06] Jost Borcherdig. Ten years of practical experience with the dreissena-monitor, a biological early warning system for continuous water quality monitoring. *Hydrobiologia*, 556:417–426, 2006.
- [Gud03] Alexander V. Gudimov. Elementary behavioral acts of valve movements in mussels (*mytilus edulis* l.). *Doklady Biological Sciences*, 391:346–348, 2003. Translated from Doklady Akademii Nauk, Vol. 391, No. 3, 2003, pp. 422-425.
- [KKCC06] Cheol-Ki Kim, Inn-Sil Kwak, Eui-Young Cha, and Tae-Soo Chon. Implementation of wavelets and artificial neural networks to detection of toxic response behavior of chironomids (chironomidae: Diptera) for water quality monitoring. *Ecol. Model.*, 195:61–71, 2006.
- [LRM08] Petrone L., Norman L. C Ragg, and A. James McQuillan. In situ infrared spectroscopic investigation of perna canaliculus mussel larvae primary settlement. *Biofouling.*, 24(6):405–413, 2008.
- [RSH⁺06] David L. Rodland, Bernd R. Schöne, Samuli O. Helama, Jan Kresten Nielsen, and Sven M. Baier. A clockwork mollusc: Ultradian rhythms in bivalve activity revealed by digital photography. *J. Exp. Mar. Biol. Ecol.*, 334:316–323, 2006.
- [Wiś91] Ryszard Wiśniewski. New methods for recording activity pattern of bivalves: A preliminary report on dreissena polymorpha pallas during ecological stress. In *Tenth Intern. Malacol. Congress*, pages 363–365, 1991.