

LAWRENCE WILLIAM SHEPPARD

CONTACT

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CURRENT POSITION

2015+ Post-Doctoral Researcher, Kansas University.

EDUCATION AND EMPLOYMENT

2011-2015 Research Associate, Imperial College.

2006-2010 PhD 'Wavelet phase dynamics of intracranial pressure monitoring' *submitted September 2010, conferred December 2010.*

Lancaster University Physics Department.

Supervisor: Professor Aneta Stefanovska. PhD funded by EPSRC.

1999-2003 BA (Hons), Master of Natural Sciences.

Downing College, Cambridge University.

RESEARCH

My work has focussed on the phase dynamics of oscillations and their interactions, using wavelet, mutual information and phase coherence methods. In particular I have examined the distinction between time-independent spectral properties of a signal and time-dependent features resulting from the exchange of information between systems.

Current topics. Determining the significance and synchronising effect of environmental and ecological influences on phenology and populations of aphids, plankton, fish and other organisms.

PhD: 'Wavelet phase dynamics of intracranial pressure monitoring.' Worked in collaboration with medical researchers at Ullevål Hospital, Oslo, Norway. Studied cerebral blood flow autoregulation in coma patients. Analysed the relationship between intracranial pressure and blood pressure data, implemented wavelet transforms in Matlab software.

Applied mutual information measures to identify characteristic waveforms at several frequencies in the intracranial pressure. Showed how the phase relationship between oscillations in intracranial pressure and blood pressure is frequency dependent and also dependent on patient health. Found a new approach to testing the significance of wavelet phase coherence by determining the dependence on signal autocorrelation and higher order statistics.

Other experience. From 2006 to 2009 I worked part time as scientific secretary on the EU NEST project, BRACCIA, studying the nonlinear dynamics of anaesthesia. I gained extensive administrative experience, assisting the project coordinator in purchasing equipment and organising international meetings, including the final conference. I was responsible for maintaining the BRACCIA web page and the secure web server for the BRACCIA database.

PUBLICATIONS

Vuksanovic V, Sheppard LW, & Stefanovska A (2008). Nonlinear relationship between level of blood flow and skin temperature for different dynamics of temperature change. *Biophysical Journal* **94** L78-L80.

Sheppard LW, Stefanovska A & McClintock PVE (2011). Detecting the harmonics of oscillations with time-variable frequencies. *Phys. Rev. E* **83** 016206.

Sheppard LW, Vuksanovic V, & Stefanovska A (2011). Oscillatory dynamics of vasoconstriction and vasodilation identified by time-localised phase coherence. *Phys. Med. Biol.* **56** 3583.

Stefanovska A, Sheppard LW, Stankovski T, et al (2011). Reproducibility of LDF blood flow measurements: Dynamical characterization versus averaging. *Microvascular Research* **82** 274-276.

Hale AC, Hansard T, Sheppard LW, et al (2012). The Kuramoto Model subject to a fluctuating environment: application to brainwave dynamics. *Fluctuation and Noise Letters* **11** 1240011.

Sheppard LW, Hale AC, Petkoski S, et al (2013). Characterizing an ensemble of interacting oscillators: The mean-field variability index. *Phys. Rev. E* **87** 012905.

Sheppard LW, Stefanovska A, McClintock PVE (2013). Testing for time-localized coherence in bivariate data. *Phys. Rev. E* **85** 046205.

Kvandal P, Sheppard LW, Landsverk SA, et al (2013). Impaired cerebrovascular reactivity after acute traumatic brain injury can be detected by wavelet phase coherence analysis of the intracranial and arterial blood pressure signals. *Journal of Clinical Monitoring and Computing* **27** 375-383.

Defriez E, Sheppard LW, Reid PC, and Reuman, DC. Climate-change-related regime shifts have affected spatial synchrony of plankton dynamics across the North Sea. *In review*.

Bahraminasab A, Drægni T, Entwistle M, Hale AC, Hasler M, Hansard T, Kenwright DA, Kvandal P, Kurths J, Landsverk SA, Oshima K, Paluš M, Ræder J, Riedl M, Smith A, Sheppard LW, Shiogai Y, Stankovski T, Stefanovska A, Šušmáková K, Vejmelka M & Wessel N. Application of nonlinear dynamics to anaesthesia: humans. In Stefanovska A, McClintock PVE, Ræder & Smith AF, editors, *Nonlinear Dynamics of Anaesthesia: From theory to clinical application*. *In preparation*.

Kenwright DA, Bernjak A, Drægni T, Dzeroski M, Entwistle M, Horvat M, Kvandal P, Landsverk S, McClintock PVE, Musizza B, Petrovčič J, Ræder J, Sheppard LW, Smith AF, Stankovski T, Stefanovska A. The discriminatory value of cardiorespiratory interactions in distinguishing awake from anaesthetised states: a randomised observational study. *In review*.

Sheppard LW, Bell J, Harrington R, Reuman DC. Changes in large-scale climate cause changes in the spatial synchrony of aphid pests. *In review*.