

Accepted Manuscript

Standing and travelling waves in a spherical brain model: The Nunez model revisited

S. Visser, R. Nicks, O. Faugeras, S. Coombes

PII: S0167-2789(16)30635-2

DOI: <http://dx.doi.org/10.1016/j.physd.2017.02.017>

Reference: PHYSD 31899

To appear in: *Physica D*

Received date: 9 December 2016

Revised date: 27 February 2017

Accepted date: 28 February 2017

Please cite this article as: S. Visser, R. Nicks, O. Faugeras, S. Coombes, Standing and travelling waves in a spherical brain model: The Nunez model revisited, *Physica D* (2017), <http://dx.doi.org/10.1016/j.physd.2017.02.017>

This is a PDF file of an unedited manuscript that has been accepted for publication. As a service to our customers we are providing this early version of the manuscript. The manuscript will undergo copyediting, typesetting, and review of the resulting proof before it is published in its final form. Please note that during the production process errors may be discovered which could affect the content, and all legal disclaimers that apply to the journal pertain.



Standing and travelling waves in a spherical brain model: the Nunez model revisited

S Visser^{a,b}, R Nicks^a, O Faugeras^c, S Coombes^{a,*}

^a*School of Mathematical Sciences, University of Nottingham, NG7 2RD, UK.*

^b*Wellcome Trust Centre for Biomedical Modelling and Analysis, RILD Building, University of Exeter, EX2 5DW, UK.*

^c*INRIA Sophia Antipolis Mediterranee, 2004 Route Des Lucioles, Sophia Antipolis, 06410, France.*

Abstract

The Nunez model for the generation of electroencephalogram (EEG) signals is naturally described as a neural field model on a sphere with space-dependent delays. For simplicity, dynamical realisations of this model either as a damped wave equation or an integro-differential equation, have typically been studied in idealised one dimensional or planar settings. Here we revisit the original Nunez model to specifically address the role of spherical topology on spatio-temporal pattern generation. We do this using a mixture of Turing instability analysis, symmetric bifurcation theory, center manifold reduction and direct simulations with a bespoke numerical scheme. In particular we examine standing and travelling wave solutions using normal form computation of primary and secondary bifurcations from a steady state. Interestingly, we observe spatio-temporal patterns which have counterparts seen in the EEG patterns of both epileptic and schizophrenic brain conditions.

Keywords: neuronal networks, integral equations, space dependent delays, dynamic pattern formation on a sphere, normal form computation, symmetric bifurcation theory.

1. Introduction

Modern neuroimaging methodologies give us a window on the activity of the brain that may reveal both structure and function. Despite the recent advances in technologies for magnetic resonance imaging (MRI) for assessing anatomy, and functional MRI for assessing functional changes over seconds or minutes, the historical predecessor of

*Corresponding author

Email addresses: s.visser@exeter.ac.uk (S Visser), rachel.nicks@nottingham.ac.uk (R Nicks), olivier.faugeras@inria.fr (O Faugeras), stephen.coombes@nottingham.ac.uk (S Coombes)

Preprint submitted to Elsevier

February 27, 2017

Download English Version:

<https://daneshyari.com/en/article/5500212>

Download Persian Version:

<https://daneshyari.com/article/5500212>

[Daneshyari.com](https://daneshyari.com)