# Letter of Interest

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I have a strong interest in working with Dr. Rodrigues, as his research is intriguing, impactful, and relevant to my interests. I particularly enjoy the direct usage of mean field models and bifurcation analyses to describe experimental observations [5, 1]. While I have experience in analyzing neural models through analytical and numerical techniques [2, 3] including a mean-field cortical model first studied in [4], my research has not yet afforded the opportunity to use experimental data to motivate the analysis.

Other publications by Dr. Rodrigues coincide strongly with my research. In [7], the authors discuss the transitions from oscillatory solutions to spike-wave solutions in a thalamic circuitry component of a mean-field model. Although I am unfamiliar with the biology of this particular problem, I recognize that the model reduction and piecewise linear approximation make the analysis tractable.

In [6], the authors consider mappings from a macroscopic cortical model to microscoptic conductance-based models. I find the generality of the models considered intriguing, as well as the authors' care to explicitly state the limitations of each assumption. As mentioned in my research statement, I have some interest in this type of analysis.

To summarize, I appreciate the biologically motivated problems that Dr. Rodrigues and colleagues address without using a purely statistical approach. If I were to join this group, I would be able to satisfy three important personal goals: first, to continue learning more dynamical systems, second, to apply the knowledge I learned throughout my doctorate, and third, to learn more neuroscience.

## References

[1] M Breakspear, JA Roberts, John R Terry, S Rodrigues, N Mahant, and PA Robinson. A unifying explanation of primary generalized seizures through nonlinear brain modeling and bifurcation analysis. *Cerebral Cortex*, 16(9):1296–1313, 2005.

[2] Youngmin Park and Bard Ermentrout. Weakly coupled oscillators in a slowly varying world. *Journal of Computational Neuroscience*, 40(3):269, 2016.

[3] Youngmin Park, Kendrick M Shaw, Hillel J Chiel, and Peter J Thomas. The infinitesimal phase response curves of oscillators in piecewise smooth dynamical systems. *arXiv preprint arXiv:1603.03503*, 2016.

[4] D. Pinto and G. Bard Ermentrout. Spatially structured activity in synaptically coupled neuronal networks: I. Traveling fronts and pulses. *SIAM Journal on Applied Mathematics*, 62(1):206–225, January 2001.

[5] Serafim Rodrigues, David Barton, Robert Szalai, Oscar Benjamin, Mark P Richardson, and John R Terry. Transitions to spike-wave oscillations and epileptic dynamics in a human cortico-thalamic mean-field model. *Journal of computational neuroscience*, 27(3):507–526, 2009.

[6] Serafim Rodrigues, Anton V Chizhov, Frank Marten, and John R Terry. Mappings between a macroscopic neural-mass model and a reduced conductance-based model. *Biological cybernetics*, 102(5):361–371, 2010.

[7] Serafim Rodrigues, John R Terry, and Michael Breakspear. On the genesis of spike-wave oscillations in a mean-field model of human thalamic and corticothalamic dynamics. *Physics Letters A*, 355(4):352–357, 2006.