Gatsby Computational Neuroscience Unit

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Director: Professor Peter Dayan

Computational Neuroscience Faculty Search Committee
c/o David Sheinberg
Department of Neuroscience
Brown University
Providence, RI

30th April 2012

Re: **Tim Vogels**

Dear David,

I am delighted to write in the very strongest support of Tim Vogels in his application for an Assistant Professor position in Computational and Theoretical Neuroscience at Brown. I came to know Tim when he was a tutor on the European Advanced Course in Computational Neuroscience in Arcachon, which I helped direct. We were so pleased with him, that we enthusiastically invited him back the next year and were delighted when he accepted.

I am tremendously impressed with Tim. He has both a broad and deep knowledge of neuroscience, showed considerable ingenuity and intellectual verve in pursuing his main PhD project, was a careful, patient and effective tutor of a diverse range of students and student projects, and designed and completed two most imaginative, diverse, challenging and interesting postdoc projects. He is one of a very few people with a firm computational and mathematical grasp as to how large, multi-layered, spiking networks can actually be made to perform interesting information processing; this shows his command of mathematical neuroscience and also of a particularly challenging aspect of non-linear dynamics.

His PhD project concerned computation in large, recurrently, coupled, networks of spiking neurons. His highly innovative approach was to recognize that random coupling between neurons creates the potential for many different sorts of virtual groups of neurons, defined by some common properties of their connections, such as all having excitatory coupling to some other, similarly virtual, group. By setting the strengths of just these synapses to be slightly different (notably, larger) from others, these virtual groups become actual, in that the patterns of activity of their neurons reflects the grouping. This process, acting through the combinatorics of connectivity, can be used to create many different sorts of computational structure in an apparently amorphous network. This opens up quite unexpected opportunities for information processing, including many different sorts of computational gate, including basic logical operations. His well-regarded papers on the topic show superior attention to detail, and are models of clarity. Tim paid close regard to biological detail in building these networks, and also worked on the implications of his findings, notably in diseases such as schizophrenia which, amongst other things, are known to involve problems with gating. Typically, rather than just make a half-hearted link to this body of work, Tim invested the time and effort to understand relevant aspects in depth.

During his postdoc with Yuste, Tim studied neurons at a finer level of detail, investigating the effects of the shape and location of synapses on morphologically complex dendritic trees and axon initial segments. His results in both these areas are most interesting. They provided him a way to answer important and pressing neuroscience questions, whilst also providing a viable path for him to learn to perform leading edge experiments in one of the best labs for this in the world. Even if his own lab is ultimately aimed purely at theory, analysis and simulation, this will have been an invaluable experience for getting to the heart of the phenomena and data that he will model, and to be a very productive collaborator with experimental groups.

For his postdoc with Gerstner, Tim started work on the issue of plasticity in recurrent networks; extensions to this will form the basis of the starting research in his own lab. In particular, Tim worked with Henning Sprekeler on a most woefully neglected problem, namely plasticity in inhibitory connections. In a lovely piece of work (which we invited him to talk about at Gatsby, and which recently appeared in *Science*), they showed the power of a simple inhibitory learning rule to create and stabilize the sort of balance between excitation and inhibition necessary for the recurrent networks to work appropriately in the regime that he identified. I think that this will be an important result, particularly as Tim develops it to look at issues around adaptive gating.

Tim's tutoring at Arcachon shows a different side of his scientific skills. He had charge of 5-6 students, working on projects across a whole range of the field. To do this effectively, he had to be able to understand their diverse issues, based on quite little information, and see how the resulting problems could be solved. He did this in an exemplary manner, and indeed is a highly effective teacher and mentor, and a good speaker. I was delighted, though certainly not surprised, to see that he has parlayed this talent into impressive supervision of PhD students in EPFL, with papers in prospect.

In sum, I think that Tim would be a wonderful addition to your faculty, and I recommend him to you without reservation. I think that he would fit particularly well in the highly collaborative environment that I understand you enjoy at Brown, and would make many connections across your faculty.

Please feel free to contact me with any questions.

Yours sincerely,

Peter Dayan
Director of the Gatsby Computational Neuroscience Unit
Professor of Computational Neuroscience, UCL