University of Pittsburgh

School of Medicine
Department of Neurological Surgery
Brain Trauma Research Center

200 Lothrop Street, Suite B400
Pittsburgh, Pennsylvania 15213
Phone: (412) 648-9654
Fax: (412) 648-2057
Email: **kriegerd@upmc.edu**

June 23, 2014

Dear Council Members:

I am honored to be considered for a seat on the OSG Council.
Below are several points by way of introduction :

1. What I can contribute to the Council.
2. The value of sitting on the Council to me.
3. The collaborative context of my research effort involving the OSG.
4. I propose to contribute to expansion of the usage of the OSG by others through an XSede gateway.

What I can contribute to the Council. I bring long time experience both as a user and as a developer of integrated real time biomedical hardware/software systems. This includes providing mission critical decision support for live surgical procedures with networks, machines, and software system as they evolved over 25+ years. This experience and perspective, my biomedical orientation, and my view of the OSG as a real time system will hopefully make me a useful and productive member of the Council.

My work since 1986 has included development and implementation of integrated hardware/software systems for monitoring real-time neurophysiological recordings during surgical procedures. This effort supported real time intraoperative monitoring by myself and other clinical staff for several university and private hospitals. Our service was ordered for cases which posed a significant threat to the brain or spinal cord and for which real time functional feedback might help avoid surgically induced injuries. During that 18 year period we handled ~25,000 cases. The service has since grown to more than 6,000 cases/year with numerous comparable and larger services modelled after ours operating in the US and elsewhere (Real Time IOM via Telemedicine).

Repeated excitation of the patient's nervous system, digitization of the evoked neuroelectric activity, signal processing, display, transmission over local and/or wide area network for interpretation by a remote professional, and feedback to the surgeon were and are handled in real time by computer system. This is one of the earliest telemedicine applications and is noteworthy in that (1) it functions in real time, (2) it provides both remote visualization of neuroelectric signals and 2-way communication via audio or chat, and (3) it was originally built on top of parallel virtual machine (PVM), a precursor to MPI. I wrote those applications in addition to implementations of several real time signal processing and data management methods.

I view the OSG opportunistic cycle stream as a volatile real time commodity since unused cycles are instantly lost. The efficient use of this formidable resource provides an invaluable asset for our scientific effort and that of others, serves as a demonstration application with numerous

unique features, and provides a significant incremental argument for justifying the financial resources required to support the hardware and software underpinnings of the OSG.

The value of sitting on the Council to me. I and my collaborators are acutely aware of the importance of the OSG to our research effort. A seat on the OSG governing Council will provide visibility for us with those who control this critical resource. It will provide us with a deeper and more comprehensive understanding of the resource. And hopefully it will provide us with an opportunity to make a substantive contribution to the development and growth of the OSG.

The collaborative context for our research effort involving the OSG. Our brain trauma research group is a tight consortium of clinician/researchers whose focus is mild, moderate and severe head injury. The work is directed by David Okonkwo, M.D., Ph.D., an eminent neurosurgeon and the clinical director of the University of Pittsburgh's Brain Trauma Research Center. Our research approach is unique in that it seeks to thoroughly characterize the clinical disorder, brain anatomy, brain function, and brain biochemistry of the individual patient. The group members represent specialties in neurosurgery, neurology, neuropsychology, anatomic and functional brain imaging, MR spectroscopy, sleep disorders, vestibular and ocular function, and post-traumatic stress disorder.

My role is to find neuroelectric measures derived from magnetoencephalography (MEG) which promote diagnosis, prognosis, and treatment of concussion, i.e. mild traumatic brain injury. This subset of head injuries is by far the most common and is, paradoxically, much more poorly understood than more severe head injuries. More than 80% of patients with concussion demonstrate no abnormalities on brain imaging. Even for those who do we do not have a confirmed mechanism by which a mechanical blow to the head can lead to either the acute or the chronic effects of concussion. My present effort includes developing a scientifically useful theory for this mechanism.

My efforts to optimize the extraction of neuroelectric information from MEG recordings initially led to a new method for solving the large systems of nonlinear equations whose solution is required (Krieger et al, Intl J Advd Comp Sci (4)1: 15-25. Jan 2014). This method, referee consensus processing, is a significant discovery in applied mathematics and is applicable to a number of other problems including microwave telescope imaging, 3D ultrasound imaging, seismic tomography, neural network analysis, and financial market linkage analysis. The markedly improved extraction of useful information using referee consensus processing has led to collaborations with neuropsychologists investigating HIV related dementia and physicists studying the cosmic microwave background.

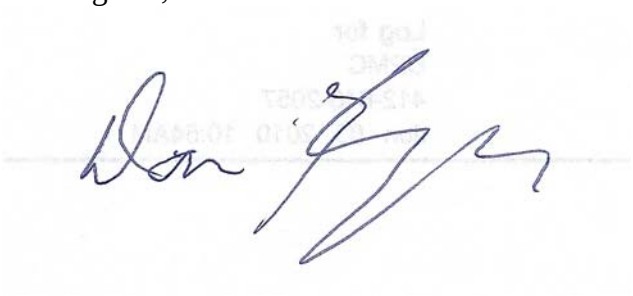
I propose to contribute to expansion of the usage of the OSG by others through an XSede gateway. The application we currently are running on the OSG is the pilot implementation of referee consensus processing, specialized for solving the MEG equations. We are in the process of rewriting the application with particular attention to the following design goals: (1) Correct the flaws and limitations in the algorithm itself which have been uncovered by our experience to date. (2) Configure and generalize the software to enable application to a range of problems specifically including neural network analysis and microwave telescope imaging. (3) Produce an XSede gateway as a front-end for both our own and our collaborators' applications.

This software development approach is dictated by the complexity of the algorithm itself and the specialized knowledge required to develop the control software . It will minimize the effort required by others to utilize referee consensus while adding new groups, users, and job load to the OSG under the control of proven software.

With the growing recognition of the transformational capability of referee consensus when applied to human magnetoencephalography, I anticipate an order of magnitude or more increase in demand for OSG cycles by other MEG groups using our XSede gateway. Those initial efforts will likely be undertaken to validate and apply the method to data they have already analyzed in other ways. Should referee consensus processing prove to be comparably effective for the neural network problem, microwave telescope imaging, and others, the potential demand for OSG cycles would be expected to easily exceed our group's current usage by 2 orders of magnitude or more.

Thank you for considering me for inclusion in the Council. I look forward to speaking with you soon and to providing answers to whatever questions you may have.

Best regards,



Don Krieger, Ph.D.