**2018 IMAG Futures Meeting – Moving Forward with the MSM Consortium (March 21-22, 2018)**

*Pre-Meeting Abstract Submission Form*

*\*Please submit to the NIBIB IMAG mailbox (*NIBIBimag@mail.nih.gov*) by* ***January 8th, 2018***

*\*Save your abstract as “MSM PI Last Name \_ 2018 IMAG Futures Pre-Meeting Abstract”*

**PI(s) of MSM U01: Gianluca Lazzi, Theodore W. Berger**

**Institution(s): University of Utah, Salt Lake City, University of Southern California**

**MSM U01 Grant Number: GM104604**

**Title of Grant:** Predictive Modeling of Bioelectric Activity on Mammalian Multilayered Neuronal Structures in the Presence of Supraphysiological Electric Fields

**Abstract**

Which MSM challenges are you addressing from the IMAG 2009 Report and how?

<https://www.imagwiki.nibib.nih.gov/content/2009-imag-futures-report-challenges>

(indicate which challenge (#) you’re addressing)

#1: We integrate biochemical processes with intra- and extracellular electrical activity;

#4: We developed novel methodologies to combine extracellular field and intracellular membrane potentials in response to external stimulation

#8: Our hippocampal multiscale model does require a high-performance cluster for parallelization of massive amounts of calculations

#9: Multiscale models are used as to predict the effects of drugs for multiple pathologies of the nervous system (in-silico drug discovery)

#18: In the context of drug discovery, our modeling platform can be used to evaluate outcomes of individualized treatments

Are you using machine learning and or causal inference methods and how?

 Yes, we use a data-driven input-output (IO) modeling approach as a solution to the scale linking problem. We run simulations using detailed (computationally heavy) mechanistic models, and use the responses obtained to build and calibrate IO models capable of efficiently extracting the functional properties of the corresponding mechanistic models, but with a considerably smaller footprint. These IO models are then used as highly efficient surrogates to constitute the building blocks of the multi-scale model, thereby making possible simulations that comprise a large number of functional units.

Please briefly describe significant MSM achievements made (or expected).

 We successfully developed computational/methodological bridges that model bioelectric responses of neuronal tissue to electrical stimulation. These methodologies enable integration of multiple dimensions: (i) the integration of multiple natures (electrical field generated by a stimulating electrode, electrophysiological neuronal responses and biomolecular mechanisms), (ii) of multiple spatial dimensions (from nanometer to millimeter scales) and (iii) of multiple temporal dimensions (from short-term (msec/sec) to long-term (minutes/hours) processes). These methodologies also enable integration of mechanistic (hypothesis-driven) and input-output (data-driven) models to realize efficient large-scale simulations while preserving meaningful nonlinear dynamics.

Please suggest any new MSM challenges that should be addressed by the MSM Consortium moving forward.

*You may insert images by copying and pasting below*

 Development of standardized strategies for multiscale models, modeling methodologies, and computational approaches

What expertise are on your team (e.g. engineering, math, statistics, computer science, clinical, industry) and who?

*Please list as “Expertise – Name, email”*

***Electrophysiology*** *- T. W. Berger,* berger@usc.edu*, D. Song,* dsong@usc.edu, *M. Humayun,* humayun@med.usc.edu*.* ***Engineering*** *- G. Lazzi,* lazzi@usc.edu*, T. W. Berger,* berger@usc.edu*, D. Song,* dsong@usc.edu*, J-M. C. Bouteiller,* jbouteil@usc.edu, *K. Loizos,* ky.lo45@gmail.com, *G. Yu,* geneyu@usc.edu*.* ***Math*** *- G. Lazzi,* lazzi@usc.edu*, T. W. Berger,* berger@usc.edu*, D. Song,* dsong@usc.edu*, J-M. C. Bouteiller,* jbouteil@usc.edu, *K. Loizos,* ky.lo45@gmail.com, *G. Yu,* geneyu@usc.edu*.* ***Statistics*** *– D. Song,* dsong@usc.edu*.* ***Computer science****, Dong Song,* dsong@usc.edu*, J-M. C. Bouteiller,* jbouteil@usc.edu, *K. Loizos,* ky.lo45@gmail.com, *G. Yu,* geneyu@usc.edu*.* ***Drug discovery*** *– J-M. C. Bouteiller,* jbouteil@usc.edu, *T. W. Berger*, berger@usc.edu*.* ***Industry****, G. Lazzi,* lazzi@usc.edu*, T. W. Berger,* berger@usc.edu*, J-M. C. Bouteiller,* jbouteil@usc.edu*.* ***Visualization****, C. Johnson,* crj@utah.edu*,* ***Clinical****, T. W. Berger,* berger@usc.edu *, D. Song,* dsong@usc.edu, *M. Humayun,* humayun@med.usc.edu

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