

Minutes of Biomechanics Working Group (BWG) Discussion Session

Ahmet Erdemir, Jay Humphrey

Meeting Date: December 12, 2013

Meeting Time: 2:00 PM (US/Eastern)

Means: Vidyo Web Conferencing

Attendees: Rouzbeh Amini
Yasin Dhaher
Ahmet Erdemir
Trent Guess
Jason Halloran
Jeff Holmes
Jay Humphrey
Peter Laz
Stephanie Sabourin
Ed Sander
Kevin Shelburne
Darryl Thelen
Jeff Weiss

Agenda:

1. Summary of 2013 Activities
2. Upcoming Initiatives
3. Transfer of Leadership
4. Potential Collaboration Opportunities
5. Other Items of Interest

Action Items:

1. Proactive submission and review of computational biomechanics proposals in cross-disciplinary review panels (All)
2. Exploring the organization of satellite meetings and sessions in conferences of allied fields (clinical or research) to promote biomechanics and multiscale modeling (All)
3. Identifying the pathway to utilize BWG as a resource for others to nucleate collaborations (All)
4. Exploring model sharing venues within and outside IMAG/MSM (All)
5. Promotion of multiscale modeling and simulation sessions at WCB 2014 (All)
6. Follow up on the possibility of publishing a multi-viewpoint, discussion type perspective article of multiscale *in silico* biomechanics in the Annual Review of Biomedical Engineering (Jay)
7. Organization of theme based multiple speaker webinars (Trent)
8. Organization of multiscale modeling and simulation session(s) at CMBBE 2014 (Ed)
9. Dissemination of recent and upcoming webinars on YouTube (Ahmet)
10. Transformation of BWG leadership (Jay, Ahmet)

Notes:

1. Check BWG at [http://www.imagwiki.nibib.nih.gov/mediawiki/index.php?title=Biomechanics Working Group](http://www.imagwiki.nibib.nih.gov/mediawiki/index.php?title=Biomechanics%20Working%20Group)
2. The unedited video recording of the discussion is available at <http://demo.replay.vidyo.com/replay/showRecordingExternal.html?key=U2bM5gLkTURYzrs>
3. **Opening of the Discussions.** Jay started the web based discussions by providing a brief history of the BWG. The group stemmed from the Tissue Mechanics Working Group, which had started in April 2006 by Trent Guess and others. In November 2010, BWG was established with Ahmet and Jay as co-leads. Since then the group hosted 1-2 webinars a year on multiscale biomechanics and involved in a number of white papers on the importance of multiscale biomechanics. This discussion's purposes were noted as to welcome new members based on new awards and to provide an overview of past year activities and future plans.
4. **Overview Presentation.** Ahmet went over the presentation, first referring to new members introduced to the BWG in 2013. Contributions by BWG to thematic seminars were noted along with BWG's involvement to organize a special session on multiscale biomechanics at CMBBE 2013. Plans for 2014 was summarized as the organization of thematic webinars, along with webinars by funded investigators; a planned multiscale modeling mini-symposium at WCB 2014; potential organization of a session at CMBBE 2014; and transfer of BWG leadership. Anyone interested in organizing a session at CMBBE 2014 were encouraged to contact Ahmet for introductions to the conference organizers. The value of IMAG & MSM were described as providing the means for the biomechanics community to interact with the broad modeling and simulation community and with investigators in different disciplines.
5. **WCB 2014.** Jay is the Program Chair of WCB 2014, <http://wcb2014.com>. A mini-symposium is planned on multiscale biomechanics, co-chaired by Ahmet Erdemir and Shayn Peirce-Cottler. All participants were asked to send Jay program related questions and inform about additional sessions, of which they are involved in the organization. Some of the planned sessions of WCB 2014 are explicitly multiscale. Overall goal is to schedule various multiscale modeling sessions throughout the meeting with the mini-symposium kick-starting the topic. Ed Sander will send information about two sessions he is responsible for. A total of 440 sessions will be held in WCB 2014, 350 planned through invitations and the remainder to be composed of unsolicited abstracts. Not all the slots in the planned sessions are filled. Unsolicited submissions will be first scheduled into these planned sessions, based on the suitability of the topic.
6. **CMBBE 2014.** There is the possibility to organize a session on multiscale modeling and simulation in CMBBE 2014. If anyone is interested in, Ahmet can introduce them to the conference organizers. CMBBE 2014 will be held in October 2014 in Amsterdam, The Netherlands. Jeff Weiss will be organizing a scientific session on FEBio and an FEBio workshop. Ed expressed interest in the organization of a prospective session and he will follow up.
7. **Webinars in 2014.** Volunteers and recommendations were requested for the webinars in 2014. IMAG already expects U01 funded investigators to present. Ed Sander recently provided a webinar, which was recorded and needs to be disseminated, ideally on YouTube. Stephanie noted that Dan Beard has a channel for posting these presentations. Ahmet will follow up with Dan to post Ed's presentation. Peter wondered if we can pick up a theme where four-five people gives a short presentation; a way to introduce others to the topic and illustrate different approaches to tackle the problem. Webinars by BWG were not in this format. Commonly, a broadly stimulating topic with a single presenter was provided, e.g., on verification and validation by Jeff Weiss, on bridging continuum-based models with agent-based models by Shayn Peirce-Cottler, on probabilistic analysis by Peter Laz. The proposed format may

introduce a wider audience to the BWG and help grow membership. The logistics to schedule multiple investigators may be challenging. All were asked to provide themes and potential lists of presenters. Trent volunteered to organize a webinar in this multi-speaker format.

8. ***Involvement in Review Panels.*** Jeff Holmes started a discussion asking whether the BWG can support the review of modeling and simulation proposals at the National Institutes of Health. Proposals with a modeling and simulation focus are commonly submitted to the the U01 mechanisms, which promotes multiscale analysis, or are assigned to MABS. This may be limiting factor to promote modeling in other disciplines and therefore in other study sections. Working group members can be more proactive to get involved with other study sections in order to establish sensitivity to modeling proposals. The following links on becoming a reviewer may be of help:

<http://public.csr.nih.gov/ReviewerResources/BecomeAReviewer/Pages/default.aspx>

<http://public.csr.nih.gov/ReviewerResources/BecomeAReviewer/Pages/How-Scientists-Are-Selected.aspx>

Grace Peng may also provide additional help for this process. The issue of study sections' workload in regard to modeling and simulation studies was also raised. MABS has approximately 75 proposals per session; three sessions are held annually. For MABS, biomechanics is a small subset whereas the discipline is in the heart of many research areas. Multiscale modeling and simulation in MABS and in IMAG is broad yet biomechanics have specific challenges and techniques. The need to have a higher volume of applications to have more reviewers to focus on biomechanics is very pertinent. Submissions of more proposals utilizing modeling and simulation may help building up the relevant pool of applications in a study section, therefore, motivating the entry of relevant reviewers in diverse study sections. Adequate representation of modeling and simulation in diverse review panels is necessary. As Jeff noted, a mixed application (experimentation and modeling & simulation combined) may be perceived differently in study sections solely focusing on experimentation or computational aspects.

9. ***Perspective Articles.*** The BWG and its predecessor had been involved with white papers, in the form of review articles and position papers. One article was published in an IEEE journal about general challenges and opportunities in computational biomechanics. A recent article leveraged the contributions by BWG members to provide insight in reporting finite element analysis studies in biomechanics. BWG remains to be a good platform to write white papers from the broader community's perspective. Ed was asked by the Frontiers in Bioengineering and Biotechnology (http://www.frontiersin.org/Bioengineering_and_Biotechnology) to propose a topic for publication. He can follow up on this as a BWG initiative. Ahmet feels the need for more in depth articles, maybe focusing on a specific tissue or area, rather than broader perspective articles in multiscale biomechanics. In that regard, Jay summarized the results of a quick PubMed search, resulting in only 12 hits for multiscale biomechanics reviews. Based on this, there may be room to provide broad perspectives in multiscale biomechanics; as Jeff Weiss put it, the current state-of-the-art and where we need to go. Jay proposed an article providing different perspectives (not necessarily an agreement) from investigators representing various schools of thought. BWG provides this diverse scientific community to accomplish this. Jay will explore this idea further by reaching out to Annual Review of Biomedical Engineering. A lead is needed to follow up this activity where many BWG members can contribute.
10. ***Interdisciplinary Outreach via Conferences.*** Kevin Shelburne asked about BWG reaching out to diverse groups through conferences of other disciplines. The tendency seems to be talking to each other in engineering, biomechanics, or modeling and simulation conferences. Kevin provided the example of a musculoskeletal modeling session in the conference of American College of Sports Medicine. Jay noted cross-disciplinary reach out as an important issue, which

had also been discussed in the US National Committee of Biomechanics. To promote biomechanics amongst allied fields, for cross-sterilization of ideas, and to engage people in different disciplines, this Committee organized Frontiers Meetings associated with conferences of other communities; the ASME Bioengineering Division and BMES, to name a few. Many different topics were explored, e.g., growth, inflammation. These satellite meetings seem to be associated with engineering oriented conferences. Nonetheless, clinical communities have a keen interest in sessions and symposia incorporating modeling, i.e., Orthopaedic Research Society organizing pre-symposium meetings and American Heart Association conferences having a few special sessions on engineering and biomechanics. Directing outreach focus to such communities may increase the chances of attracting clinicians to the broader discipline of biomechanics and the specific utility of multiscale modeling and simulation. While it is relatively easy to organize satellite meetings and sessions in conferences, such activities require finding leads who are passionate and have the time to help organize.

11. **BWG as a Resource for Modeling & Simulation.** Jeff Holmes introduced the idea of BWG serving as a resource for those who may want to be introduced into multiscale modeling and simulation in biomechanics. He provided an example of a consortium by the NIH as an independent testing resource to identify drug pathways. Maybe investigators (funded by NIH) can approach BWG to learn how modeling and simulation can be helpful for their research. BWG can act as a matchmaker forming bridges between computationally focused scientists and engineers of the group and external investigators, who may not have the experience in modeling and simulation. Such an activity may provide incentive for people to join the group (enticed by increased visibility) and will also promote the utility of modeling and simulation. Relevant reach out activities can be supported by current information distribution mechanisms of the IMAG and MSM: the MSM e-mail list, IMAG/MSM friends group, and the working groups.
12. **Model Sharing.** Peter raised the issue about model sharing and asked if there are mechanisms to post models and a possibility for the BWG providing a clearing house. The IMAG / MSM has an index of models initiated by the Model and Data Sharing Group. Members can post information about their disseminated models there or provide links in the resources pages of the IMAG wiki. Stephanie mentioned transitioning of the wiki to a newer platform which may include forms for model entries. In this regard, any suggestions to organize the models and the links to outside repositories that house models will be appreciated. The BWG can ask its membership roster to provide links at the BWG page for the models and software they are willing to share. Jeff Weiss noted that Chris Jacobs has been working with NIH and several publishers on the development of a model sharing infrastructure. This is a separate activity from Chris Jacob's recent book and from the IEEE initiative started by Grace Peng. Jeff also asked participants about their approach dealing with dissemination of models and sharing of data. He utilizes self-publishing but has concerns about longevity of such repositories. Ahmet utilizes SimTK.org infrastructure and disseminates models and data before a publication is submitted for review. He currently experiments with a purely open development approach. Large datasets, e.g., image sets, storage intensive models, can be problematic to host. Ed mentioned a new journal to get credit for publishing data, <http://www.nature.com/scientificdata/>. This is a good initiative, to provide data description in a unified manner and to establish a permanent and unique identifier (digital object identifier) to the data description. Unfortunately, it falls short of providing the means to host the data.
13. **Data for Modeling.** Rouzbeh asked the possibility to use the working group as a platform to provide service for clinicians and for motivation of collection of data necessary to build and validate models. There is a need for in vivo data to develop the models, which can be acquired through clinicians who have access to patient populations. The BWG may need to establish a structured way to reach out clinicians and investigators who can deliver data to support

modeling and simulation efforts.

14. **Transfer of Leadership.** The co-leads would like to initiate the transfer of leadership in BWG. Those with an interest or who has recommendations are encouraged to contact current co-leads. Ed has shown an interest. Nonetheless, he is also working with the Cell-to-Macroscale Working Group. He will follow up to see if he can invest his time for BWG as well. Jay announced that Muhammad Zaman of Boston University has expressed an interest to become a co-lead in the working group. Muhammad's research is at the cellular scale moving up to the tissue scale. Anyone, who has an interest in complementing Muhammad's spatial scale of expertise at a co-leadership position, is encouraged to contact Jay. Such an arrangement will continue tradition of the complementary domains of co-leaders, e.g., Ahmet and Jay, pivoted at the spatial scale of tissue, one representing orthopaedics, the other cardiovascular. Stephanie noted that new UU01 grantees had previously expressed co-leading the BWG. She will forward the grantee names to Jay and Ahmet.
15. **Overview of IMAG/MSM/Working Groups.** Per Rouzbeh's request, Ahmet provided a brief summary of IMAG, MSM, and BWG. IMAG, the Interagency Modeling and Analysis Group, consists of various federal agencies and their corresponding officers to promote computational modeling and simulation for scientific research. MSM, the Multiscale Modeling Consortium, consists of investigators funded through programs initiated by the IMAG. Currently, the U01 program (PAR-11-203) is the prominent funding mechanism, providing support from NIH, NSF and FDA. The funded investigators usually establish and lead working groups, where anybody who has interest may follow and join. The working groups may focus on technology, broadly applicable issues, specific disciplines or specific scales. This broad structure provides a communication framework between funding agencies, investigators and the broad community of modeling and simulation to exchange ideas about multiscale analysis and to discuss common problems. The IMAG/MSM listserv and the wiki (<http://www.imagwiki.nibib.nih.gov/>) facilitate these interactions.