Interagency Modeling and Analysis Group (IMAG)
Multiscale Modeling (MSM) PI Consortium Meeting

MSM Next Steps for 2006

Compiled from February 6, 2006
Breakout Session Reports
Summary of Breakout Sessions
Large Group Discussion
Next Steps Discussion

Intent of the MSM Solicitation – Two Goals (Breakout Session Discussions)

1. **Model Sharing**
   - To develop methodologies within the local multidisciplinary team and within the larger Framework environment
   - To further promote multiscale modeling through model sharing

2. **Scientific Collaboration**
   - To develop new methodologies that span across biological scales
   - To develop multiscale methodologies applicable to biomedical, biological and behavioral research

Individual Breakout Session Reports on 2 Goals, presented by PI chairs and Summaries by Grace Peng

Biological Group

Participants:
Glazier – developmental (PI chair)
Shvartsman - developmental
Head-Gordon - signaling
Kamm – micromechanics
Kirschner - immunology
Ladd - actin
Ortoleva - microbial
Pierce - DNA
Schieber - polypeptides
Taufer – polypeptides

1. Biological Group - Strategies for **Model Sharing** –
    a. Report by James Glazier
        i. Smaller, more focused topical meetings involving subsets of PIs to develop real collaborations
        ii. Fibrous modeling dynamics, intracellular organelles, organelles to cells to tissues
        iii. Mark up language and ontology; cellML, fieldML a good start but more needed
        iv. Need for a meta language that deals with multiple modeling approaches
        v. What would it take to make CellML more amenable to a wider range of simulation types (reaction kinetics and fininte element models)
        vi. Need a noncomputational way to get to modeling
        vii. Huge effort (20x) to get from simple code to something people can use (even more – another 20x – for nonexperts
        viii. Interoperability may be a solved problem – lots of software out there?
        ix. Not ready for knowing how to package these models yet – importance of setting up structures that can evolve over time
        x. Need to start discussing standards from the beginning. Hard to fix interoperability challenges at the end. Don't want to over invest in "packaging" initially
        xi. Maintain a "light touch" – don't force collaborations, partnerships. Many of these may be outside IMAG.
        xii. Need to know more what IMAG PIs are doing before answering these questions and finding solutions. Organize into groups over the next few months and then meet again. Too many scales to be forced together. Time and money issue for more of these meetings.
        xiii. Prototypes? What worked/didn't work? Need to be building on each other's experience not just generalities. Need the science first. Actually putting together work floes. More than just the PIs – postdocs, students, co-PIs. Need strong intellectual justification to balance time/cost. Organize from outside (keep the feds out)
    b. Summary by Grace Peng
        i. Lack of consensus in group
        ii. Little agreement, feeling of frustration, lack of scientific information
        iii. Presentations by all 24, or by small subgroups would be helpful
        iv. Desire intensive discussions through white board
        v. Mis-assignment of groups, more opportunities of serendipitous contacts, diversity of opinions
        vi. 50/50 split with discussion on ontologies and markup languages, discussion of information that exists
        vii. To early to crystallize markup languages, ontologies?
        viii. Collaboration among themselves

ix. Prefer light touch from funding agencies, collaborations outside of IMAG

2. Biological Group - Strategies for **Scientific Collaboration** –
   a. Report by James Glazier
      i. Web-based sharing mechanisms? Each PI curating their own site with a common jump-off place to get to each other's sites. Breeze Tcons (can talk to each other and see shared information on your computer)? WIKI?
      ii. Help with nucleation among IMAG PIs needed but balanced with self-selection. How to make this happen more effectively than today?
      iii. Fast mechanism for small scale workshop funding. Zero funding strategy involving items in (1) above?
      iv. What is main obstacle? Finding experimentalists? Computationalists? In either case there needs to be mutual interest. Symetric interests/issues from both sides.
      v. Validation issue – 2 step process. Equation and numeric solution. Much energy to ensure code numerics reflect underlying equations. Set of standards to validate underlying equations. Other important standards.
      vi. How to mine each other's capabilities? Post a few key papers representing each person's interests/capabilities on your web site? Many things of interest that many may not even have written about so more than just literature references - key questions, challenges, uncertainies, blocks. IMAG website section accessible only by PIs to facilitate sharing of "information" you wouldn't want to post on a public web site?
      vii. Blind-date strategy for future solicitations. Alternative strategy for pairing scientists. Coffee breaks more important. Less is more in organizing a meeting like this.
      viii. 10 keys words in methods and in applications used by each PI
   b. Summary by Grace Peng
      i. Web-based sharing mechanisms, developed by each PI
      ii. Video conferencing and Wiki's
      iii. Didn't address sharing and interoperability at a technical level – future discussions
      iv. Record of what works and what does work
      v. Ortoleva – structured workflows
      vi. Smaller, more focused meeting with Postdocs and Students
      vii. Heterogeneous biological problems difficult to generalize
      viii. Did not discuss validation – focus of future meeting
      ix. Pursue email conversations over the next few months with smaller groups

Cardiovascular and Pulmonary Group

Participants:
Baracos – tissue engineering
Bassingthwaighte – muscle physiology
Beard - metabolism
Cabrera - metabolism
McCulloch - physiology
Karniadakis - blood
Lin - lung
Kunz – lung (PI chair)

1. Cardiovascular and Pulmonary Group - Strategies for **Model Sharing** –
    c. Report by Robert Kunz
        i. Identify elements/components within projects that are of interest to other investigators in other projects
        ii. Initiate a subgroup to focus on methods for sharing algorithms in a standard way;
        iii. Initiate a subgroup to define scale-spanning requirements (information exchange/loss & retention);
        iv. Make use of portable encodings and markup languages;
        v. Identify and share personal experiences in the utilization of already existing modeling tools;
        vi. Identify data sets that are available for model verification and validation.
    d. Summary by Grace Peng
        i. Subgroup to focus on sharing algorithms in a standard way
        ii. Subgroup to determine scale-spanning requirements
        iii. Identify datasets for model verification
        iv. Have benchmark problems for interested parties to work on
2. Cardiovascular and Pulmonary Group - Strategies for **Scientific Collaboration** –
    a. Report by Robert Kunz
        i. Plan and carry out a face-to-face, Gordon-type conference to enable real collaborations to develop among small sub-groups of investigators;
        ii. Develop a portal that makes cyber-infrastructure middleware available to investigators;
        iii. Establish benchmark/challenge problems for evaluation of modeling algorithms at different scales;
        iv. Establish benchmark data sets for use with different modeling scales;
        v. Develop data standards for use in data encoding; and
        vi. Establish a collaborative Wiki or method to allow ongoing interaction among the investigators.
    b. Summary by Grace Peng

i. Organize Gordon-type conference to enable sub-group collaboration
ii. Develop a portal for collaboration

Other Systems Group

Participants:
Brain – Cai
Brain – Choe (PI chair)
Gastrointestinal - Brasseur
Musculoskeletal - Guess
Immunology - Kirschner
Cancer – Luebeck
Cancer - Wilson

1. Other Systems Group - Strategies for **Model Sharing** –
    a. Report by Yoonsuck Choe
        i. Develop a flexible sharing framework
            1. Create a repository with software packages with focus on code modules
            2. Or Create environment to links and access to multiple repositories
            3. Website of documentations and guides on how to use the repositories
            4. And Secured (e.g., Lionshare-like) site on how to share
            5. Transparency (e.g. tests), documentation, meta data in the repositories
            6. Sharing the "know how" as well as code/data
            7. Clearly specified assumptions about the models
        ii. Need to continually maintain the repositories
            1. Specific supplement support (to graduate students or technical personnel), or separate support devoting to further develop the package and documentations to make them useful to the broader research community
    b. Summary by Grace Peng
        i. Good agreement among group
        ii. Different strategies depending on who is sharing
        iii. Create flexible sharing environment with repositories and websites with documentation
        iv. Create several linked repositories in a secured environment like Lionshare
        v. Share know-how as well as code/data
        vi. Ensure transparency by providing test data, meta data in repositories

vii. Continued maintenance of repositories through supplement mechanisms in granting agencies

2. Other Systems Group - Strategies for **Scientific Collaboration** –
    a. Report by Yoonsuck Choe
        i. a website
        ii. links to other methods, more than just algorithm for simulation as a process, e.g., algorithm to estimate parameters and algorithm for predictions
        iii. Meetings
            1. Scientific sessions during PI meetings
            2. Meeting in conjunction to other scientific meetings
            3. Video conferencing (internet meeting)
            4. Link to other communities doing multi-scale meeting
            5. List serve: topical subscription
            6. Link to other governmental programs
    b. Summary by Grace Peng
        i. Create website
        ii. Links to other methods, framework for estimation of parameters
        iii. Meetings
            1. Scientific sessions during PI meetings
            2. Meeting in conjunction w/ other scientific meetings
            3. Video conferencing (internet meeting)
            4. Link to other multiscale modeling communities, identify these groups
            5. Link to other government programs

Large Group Discussion – Final Strategies for 2 Goals

1. **Model Sharing**
    a. Agreement that IMAG present an implementable sharing infrastructures to entire MSM Consortium
        i. What does the MSM consortium want to put in a repository?
        ii. Needs of users of the repository
        iii. Restrict sharing to MSM Consortium – less effort
    b. Start with most open repository
    c. Single repository cleaner and much more attractive OR Linked repositories serve the same purpose
        i. Closer look at Lionshare vs. SIMBIOS, CellML
        ii. Look at tools for keyword searching
        iii. Hierarchical approaches in CellML approach
        iv. Much more flexibility within MSM Consortium
    d. Creation of Working Groups
    e. Short Term Goals – immediate (<1 month) software repository not needed by the MSM Consortium
    f. Long Term Goals – end of 3 years

        i. series of white papers on model sharing
    g. Create a working group to compare model sharing opportunities
        i. Participants of these environments as part of working group, not the developers themselves, SWOT analysis
    h. Look at implementation issues, maintaining server, process more important
    i. Develop working group on interoperability
    j. Develop working group on markup languages, with people not already involved in markup language discussions
    k. Creation of Working Groups
        i. ACTION – send out to MSM Consortium to edit and sign up
        ii. ACTION - send out to IMAG to assign to working groups
        iii. ACTION – 1st report back in 2 months (April 1st), IMAG meeting April 4th
2. **Scientific Collaboration**
    a. Meeting and face to face interactions
    b. Websites, portals – Andrew McCulloch

Next Steps for MSM Solicitation

1. Future solicitations focused on solving complex problems with multiscale approaches, in addition to generating algorithms – service to more theme oriented programs (e.g. Virtual Soldier)
2. Identifying important biological problems, e.g. Specific physiological system, justify importance
3. AND addressing fundamental biological problems
4. Focus on key roadblocks to multiscale modeling
    a. On biological side and on computational side
5. Address predictive power of code
6. Build in funds for more intragroup collaborations
    a. opportunities for students to travel
7. Budget for making code more disseminatable to the general public?? (not desired by MSM Consortium)
8. Budget for making data cleaner – supplemental funds
9. Encourage collaborations with MSM Consortium
    a. end users, public private partnerships
10. Should not resubmit to individual government agencies, need to maintain interagency effort for funding to preserve Consortium
    a. Need to keep critical mass of group
11. Revisit issue of longer (> 3 years) term of model sharing in next PI meeting
    a. Working groups should determine intermediate goals

MSM Working Groups and Potential Participants

Working Group #1
Filament dynamics, coupling molecular dynamics and continuum dynamics
Kamm, Schieber, Barocas, Ladd, Karniadakis, Brasseur, Ortoleva

Working Group #2
Cardiac and Skeletal Muscle Physiology
Cabrera, Beard, Hunter, Chizeck, Bassingthwaithe, McCulloch

Working Group #3
Cardiovascular and Pulmonary – hemodynamics and fluid dynamics
Hunter, McCulloch, Kunz, Lin, Karniadakis, Cabrera, Brasseur, Hoffman, Tawhai

Working Group #4
Agent based models of cell to tissues, Developmental Biology and Oncology
Glazier, Schvartsman, Luebeck, Barocas, Hunter, Ortoleva

Working Group #5
High-Performance Computing Group, computational issues and algorithms
Taufer, Luebeck, Karniadakis, Barocas, Glazier, McCulloch, Cai, Chizeck, Brasseur

Working Group #6
Tissue Mechanics
Guess, Lin, Tawhai

Working Group #7
Multiscale Imaging
Choe, Hoffman, Kunz, Brasseur

Working Group #8
Leads of all 7 working groups
HEAD LEAD – Hoffman with IMAG

*Note Red highlight indicates Working Group Chair