Setting up TEAMS
for Biomedical Digital Twins
(Teaming4BDT)

September 30 - October 2, 2024 | NIH Bethesda, MD

2024 Interagency Modeling and Analysis Group (IMAG) - Multiscale Modeling (MSM) Consortium Meeting

Setting Up TEAMS for Biomedical Digital Twins

(Teaming 4BDT)

Neuroscience Center Building (NSC)
6001 Executive Boulevard
Rockville, MD 20852
September 30 – October 2, 2024
www.imagwiki.nibib.nih.gov/

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Welcome!

The 2024 IMAG/MSM meeting takes the NASEM definition of a digital twin and focuses on Biomedical Digital Twins (BDT). BDT will have digital twin challenges that are inherently unique to biomedical, biological and behavioral systems - features and limitations that may not be encountered in other digital twin domain areas. It is recognized that the vast majority (if not all) current MSM research and development projects do not meet the criteria for a NASEM defined digital twin, and less so for BDT.

Our vision for this meeting is to set up teams for Biomedical Digital Twins (Teaming4BDT) is to create a community of expertise from academia, industry, medicine and government to promote, empower, and facilitate the understanding, collaboration, creation of tools and infrastructure for biomedical digital twins (BDT).

Our meeting goals are the following:

1) Understand and use best practices in team science to create multidisciplinary teams that can meet the NASEM digital twin challenges - for BDT applications.

2) Develop a mutual understanding of the components associated with the NASEM defined digital twins, and identify unique biomedical features and limitations for each component; to create a BDT requirements template for users to explain their BDT to others.

3) Meet a network of experts to address the challenges associated with developing BDT, with existing resources; to create a BDT assessment template for users to measure the degree of readiness/maturity of a NASEM defined BDT.

4) Form mock teams to develop present BDT ideas for actionable feedback from this peer community; to allow attendees to operationalize both BDT templates (requirements and review); to produce realizable NASEM defined BDT ideas; to train and promote the development and review of BDT in broader communities.

We look forward to three invigorating days!

Acknowledgements

The organizers appreciate the time and effort, and expertise from the following:

Agenda

September 30, 2024 - Day 1: Defining Biomedical Digital Twins (BDT)		
Click Here to view speaker information		
Key: ☐ BDT Project Idea, ☐ BDT Components, ☐ BDT Requirements, ☐ Assessment Criteria		
Time & Location	**Activity**	**Organizers**
8:00-8:30am Atrium, Poster Room	Check-in at Registration Set up posters	Registration Desk
8:30-8:45am Main Meeting Room	Welcome **Meeting Vision and Goals**	**IMAG:** Grace Peng **MSM:** Gary An
8:45-9:15am Main Meeting Room	**NASEM Digital Twin Definition and Application to Biomedical Research**	**Speaker:** Caroline Chung **Moderator:** Gary An
9:15-10:15am Main Meeting Room	**Panel Discussion: Unique Features of Biomedical Digital Twins:** **Examples of Pre-Meeting Exercise #1**	**Moderator:** Caroline Chung **Speakers:** William Lytton, Carlos Lopez, Gary An, Peter Hunter
10:15-10:45am Cafeteria, Poster Rooms	AM Refreshments View Posters	Refreshments Courtesy of the Society for Mathematical Biology
10:45-11:45am Main Meeting Room	**Breakout Discussion: Apply the NASEM Definition to Your** **Biomedical Digital Twin Idea - Addressing Fit for Purpose**	**Lead Moderator:** Michelle Bennett **Room Moderators:** Caroline Chung, William Lytton, Carlos Lopez, Gary An, Peter Hunter
11:45-1:00pm Poster Room Main Meeting Room	Lunch and Networking View Posters Post BDT Ideas	Walk to Pike & Rose

September 30, 2024 - Day 1: Defining Biomedical Digital Twins (BDT)		
Click Here to view speaker information Key: ☐ BDT Project Idea, ☐ BDT Components, ☐ BDT Requirements, ☐ Assessment Criteria		
Part 1: 1:00-1:30pm Part 2: 1:30-2:00pm Main Meeting Room	**Addressing Gaps and Challenges for Successful BDT Implementation - Part 1** **NASEM DT Components - Beyond Fit-for-Purpose** Part 1: Technical Components Part 2: Social Components	**Moderator:** Gary An **Speakers:** Reinhard Laubenbacher, Julian Goldman, Michelle Bennett, Barbara Evans
2:00-4:00pm Introductions: 2:00-2:30pm Round 1: 2:30-3:15pm Round 2: 3:15-4:00pm Breakout Rooms A, B, and C	**Breakout Session #1: Generating Requirements for BDT** **Breakout Room A:** Verification, Validation, and Uncertainty Quantification (VVUQ); Mathematical and Statistical Foundations for BDT **Breakout Room B:** Physical Assets/Data Collection/Sensors; Virtual to Physical Control Algorithms/Expert in the Loop **Breakout Room C:** Ethical, Security Issues; Team Science, Governance	**Introduction:** Michelle Bennett **Breakout Room A:** Reinhard Laubenbacher, Anirban Chaudhuri; Scribes: Virginia Pasour, Fariba Fahroo **Breakout Room B:** Julian Goldman, Sandy Weininger; Scribes: Julia Berzhanskaya, Yulia Gel **Breakout Room C:** Barbara Evans and Michelle Bennett; Scribes: Hannah Dueck, Elena Sizikova
4:00-4:30pm Cafeteria, Poster Rooms, Main Meeting Room	PM Refreshments View Posters Post BDT Ideas	Refreshments Courtesy of the Society for Mathematical Biology
4:30-5:00pm Main Meeting Room	**Preparing for Teaming Day 2:** **Create Initiative BDT Teams Around BDT Ideas**	**Moderator:** Michelle Bennett
4:55-5:00pm	**Conclude Day 1**	**Speakers:** Grace Peng, Gary An, Michelle Bennett
5:00pm	Adjourn Day 1	Dinner & Bocce at Pinstripes

October 1, 2024 - Day 2: Approaches to address BDT challenges

Click Here to view speaker information

Key: ▢ BDT Project Idea, ▢ BDT Components, ▢ BDT Requirements, ▢ Assessment Criteria

Time & Location	Activity	Organizers
8:00-8:30am Atrium, Poster Room	**Check-In** View poster comments	Registration Desk
8:30-8:45am Main Meeting Room	**Welcome Back** Recap from Day 1	**Speakers:** Grace Peng, Julia Berzhanskaya, Eric Stahlberg, Michelle Bennett
8:45-9:15am Main Meeting Room	**Report Back on Requirements Template for BDT**	**Speakers:** Gary An, Reinhard Laubenbacher, Ralph Smith, Sandy Weininger, Julian Goldman, Michelle Bennett
9:15-10:15am Main Meeting Room	**First BDT Ideas Teaming Session Breakout Discussion** **Round #1:** "Getting Started: Using the Definition"	**Moderator:** Michelle Bennett
10:15-10:45am Poster Room	AM Refreshments View Posters	Refreshments Courtesy of the Society for Mathematical Biology
10:45-11:45am Main Meeting Room	**Addressing Gaps and Challenges for Successful BDT Implementation - Part 2** Deeper Dive into BDT Components	**Moderator:** Julia Berzhanskaya **Speakers:** Natalia Trayanova, Ralph Smith, Maria Eduarda Montezzo Coelho, Barbara Evans
11:45-12:00pm Main Meeting Room	**Introduction to Breakout Group Session #2: Generating Assessment Criteria for BDT**	**Speaker:** Michelle Bennett
12:00-1:15pm Poster Room	Lunch and Networking View Posters	Pike & Rose

October 1, 2024 - Day 2: Approaches to address BDT challenges [Click Here](#) to view speaker information Key: ☐ BDT Project Idea, ☐ BDT Components, ☐ BDT Requirements, ☐ Assessment Criteria		
Main Room	Post & Respond to BDT Ideas	
1:15 - 2:45pm Breakout Rooms A, B, and C	**Breakout Session #2: Generating Assessment Criteria for BDT** **Breakout Room A:** Modularity/Interoperability/Systems of Systems Mindset **Breakout Room B:** Sustainability, Regulatory Issues **Breakout Room C:** Data/Knowledge Systems	**Breakout Room A:** Natalia Trayanova, Peter Hunter; <u>Scribes</u>: Zhilan Feng, Sandy Weininger **Breakout Room B:** Maria Eduarda Montezzo Coelho, Barbara Evans; <u>Scribe</u>: Yulia Gel **Breakout Room C:** Ralph Smith, Eric Stahlberg; <u>Scribes</u>: Yuliya Gorb, Julia Berzhanskaya
2:45-3:15pm Poster Room	PM Refreshments <u>View Posters</u> Post & Respond to BDT Ideas	Refreshments Courtesy of the [Society for Mathematical Biology](#)
3:15-3:45pm Main Meeting Room	**Report Out on Assessment Criteria Templates for BDT**	**Speakers:** Natalia Trayanova, Maria Eduarda Montezzo Coelho, Ralph Smith
3:45-4:30pm Main Meeting Room	**Second BDT Ideas Teaming Session** **Round #2:** "Thinking About the Requirements and Assessment Criteria Templates"	**Moderator:** Michelle Bennett
4:30-5:00pm	**BDT Teams Report on Progress** Feedback and Feedforward Exercise	**Moderator:** Michelle Bennett
5:00-5:10pm	**Conclude Day 2** Day 2 Accomplishments and Plans for Day 3	**Speakers:** Grace Peng, Julia Berzhanskaya, Eric Stahlberg, Michelle Bennett

Time & Location	Activity	Organizers
October 2, 2024 - Day 3: Operationalizing Team Science for BDT Click Here to view speaker information Key: ☐ BDT Project Idea, ☐ BDT Components, ☐ BDT Requirements, ☐ Assessment Criteria		
8:00-8:30am Atrium, Poster Room	Check-In Review posters	Registration Desk
8:30-8:45am Main Meeting Room	**Welcome Back**	**Speakers:** Grace Peng, Hannah Dueck, Michelle Bennett
8:45-9:00am	**Recap: Requirements Template and Assessment Criteria/Questions**	**Moderator:** Hannah Dueck
9:00-10:00am Main Meeting Room	**Third BDT Ideas Teaming Session** **Round #3:** "Creating a Pitch: Putting it All Together"	**Moderator:** Michelle Bennett
10:00-10:30am Poster Room	AM Refreshments	Refreshments Courtesy of the Society for Mathematical Biology
10:30-12:30pm Breakout Rooms A, B, and C	**Pitches and Testing Assessment Criteria** Pitches by BDT Idea Teams	**Breakout Room A:** Feilim Mac Gabhann **Breakout Room B:** Bruce Lee **Breakout Room C:** Carlos Lopez
12:30-1:45pm	Lunch & Networking	Pike & Rose
1:45-2:15pm Main Meeting Room	**Full Group Debrief on Pitch/Assessment Sessions**	**Presenter:** Michelle Bennett
2:15-2:45pm	**Next Steps - Biomedical Digital Twins**	**Moderators:** Gary An, Hannah Dueck

October 2, 2024 - Day 3: Operationalizing Team Science for BDT Click Here to view speaker information Key: ▢BDT Project Idea, ▢BDT Components, ▢BDT Requirements, ▢Assessment Criteria		
2:45-3:30pm	**Conclude Conference**	**Moderator:** Grace Peng

IMAG Wiki Resources

IMAG Wiki Home Page:

Agenda ›

Biomedical Digital Twin
Networking Resources ›

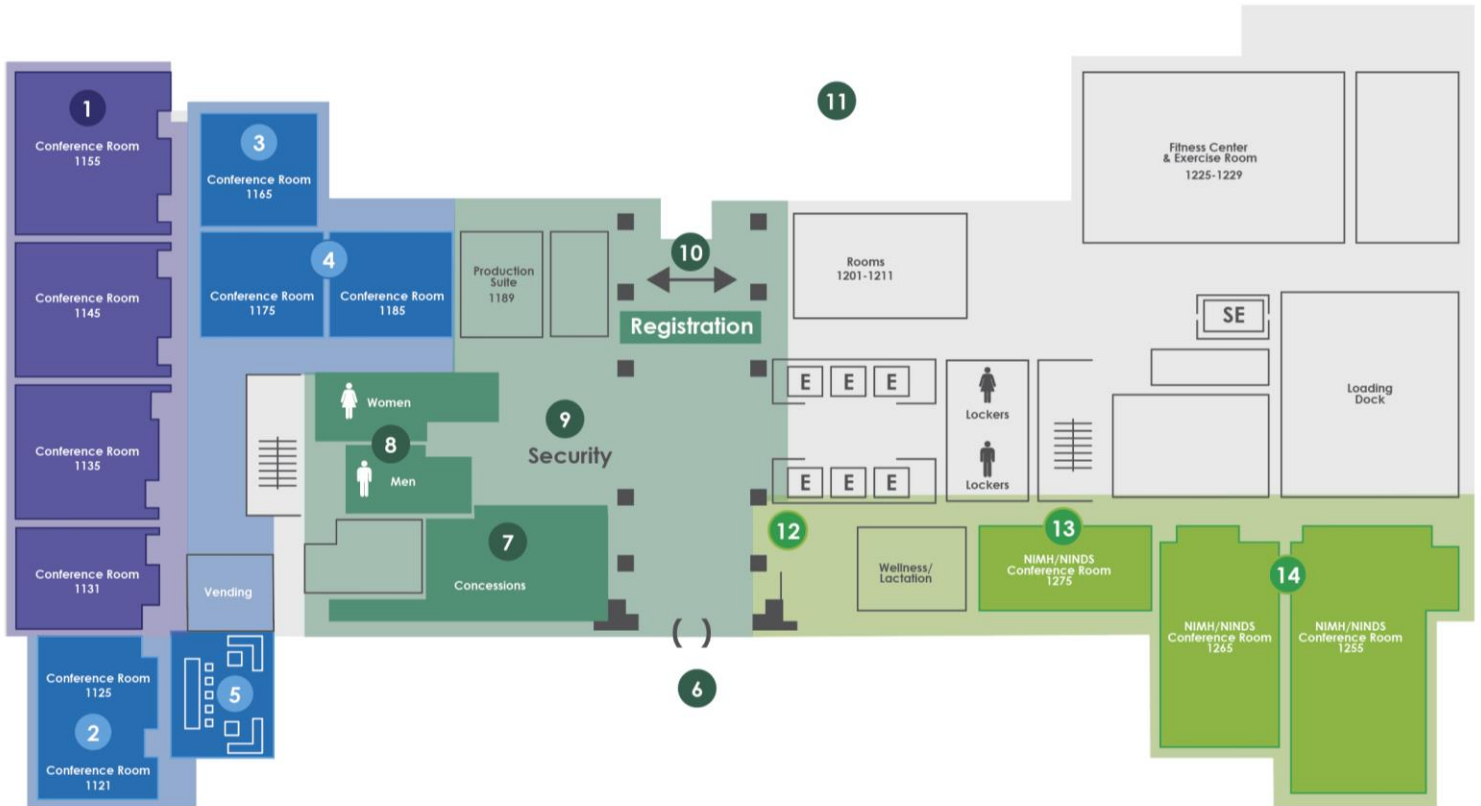Posters & Presentations ›

Attendees ›

Logistics ›

Submit Materials (you must be
registered and logged in) ›

Floor Plan: Neuroscience Center Building (NSC)

KEY   Function | Room Number

1   Main Meeting Space | Rooms 1155, 1145, 1135, 1131
            Day 1, 3: Breakout Room A
            Day 2: Breakout Room A, C
2   Poster Room | Rooms 1125, 1121
3, 4   Breakout Room B | Rooms 1185, 1175, 1165
5   AM Refreshments
6   Entrance
7   PM Refreshments
8   Restrooms
9   Security
10   Check In and Registration
11   Parking
12   Entrance/Walkway to Breakout Room C and Speaker Ready Room
13   Speaker Ready Room | Room 1275
14   Breakout Room C | Rooms 1265, 1255 (Days 1 and 3)

Notes

The 2024 Teaming4BDT Planning Committee

- Gary An, MSM
- Jeff Buchsbaum, IMAG
- Julia Berzhanskaya, IMAG
- Caroline Chung, MSM
- Hannah Dueck, IMAG
- Fariba Fahroo, IMAG
- Zhilan Feng, IMAG
- Yulia Gel, IMAG
- Yuliya Gorb, IMAG

- Peter Hunter, MSM
- Bruce Lee, MSM
- Carlos Lopez, MSM
- Orlando Lopez, IMAG
- Feilim Mac Gabhann, MSM
- Virginia Pasour, IMAG
- Eric Stahlberg, MSM

IMAG Co-Chairs
Grace Peng, NIBIB
Reed Shabman, NIAID
Elizabeth Ginexi, NCCIH

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The National Institutes of Health for hosting the meeting

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