

# Breakout #3

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# Suggested Discussion Points

*M&S in Robotics: concrete next steps. Possible breakthroughs. Speculations about disruptive technologies vis-à-vis the issue of M&S in Robotics.*

- *Low hanging fruit.*
- “The long view” issues.
- Imminent landscape changes.
- Prioritization aspects. Spectacular-return-on-investment opportunities.
- The role of industry (video-games, VR, AR). What/How can we leverage? How to engage?

Let's not just think about the end-goal  
think about how to get there

# Roadmap for Open-Source Benchmark Suites

- Open-source/shared repositories
  - benchmarks, challenge problems
  - robot worlds/tasks of varying complexities
  - modeling tools
  - algorithms, realistic datasets
- Evaluation pipelines
  - validate models/simulators against standard (stochastic) benchmarks and compare to other solutions
- Coordinated Physical Testbeds & Benchmark Tasks

# Roadmap for Creating Modeling Standard

- Establish modeling format(s) that support sharing across different simulators.
- Create models at different abstraction/fidelity levels
  - prioritize creation of simple models
  - analyze and document what we lose with simpler models
  - analyze and document trade-off between speed and fidelity
- Push for easy-to-use models/simulators - plug-in style
- Interface that allows for data-driven methods

# Build Community

Closer interaction and collaboration between roboticists, model/simulation tool developers and machine learning researchers

- Get more researchers excited and interested in modeling & simulation for robotics
  - tutorials/workshops at robotics conferences
  - add training/education about M&S to robotics training curriculum
- Create tutorials/how-to-guides
  - how to choose the 'right' simulator
  - create pro/cons for different simulators/models
- Organize contests
  - grand challenges

# Funding Opportunities

- Funding for more meetings like this one
  - for example: get researchers with different simulator tools together
- Support by research industry and national funding agencies
  - open source simulator/models for all robots in the market
  - software engineering
  - maintenance/support
  - documentation
- Fund multiple competing efforts (similar to TensorFlow, PyTorch, etc.), and let people choose what fits best

# Other Concrete Suggestions

- Combine data-driven methods with analytical models
  - Use real data to ‘identify model’ or ‘calibrate simulator’
  - Explore ways to couple simulation to reality on a continuous basis
- Combine simulators with game-engine technology
- Crowd source model and environment creation
- Utilize more precise simulators from other fields of mechanics / physics + cloud computing