

## Other Products

The activity continued dissemination of computational models (and data) of the knee as a resource. For more details on model and data sharing, please refer to progress on Resource Sharing. The activity also resulted in generation and dissemination of various documents. These include various user documentation and mature specifications for development of knee joint models. All such products are listed in the “Documents” section of the project website at <https://simtk.org/home/openknee>. The information is disseminated using the Creative Commons Attribution-ShareAlike 3.0 Unported (CC BY-SA 3.0) license, see <http://creativecommons.org/licenses/by-sa/3.0/>. This license allows anyone to share (to copy, distribute, transmit the work), to remix (to adapt the work), and to make commercial use of the work under the following conditions: i) attribution – one must attribute the work in the manner specified by the author or licensor (but not in any way that suggests that they endorse you or your use of the work); ii) share alike – if one alters, transforms, or builds upon this work, one may distribute the resulting work only under the same or similar license to this one. This licensing scheme provides utmost dissemination and promote open science. It also does not restrict any type of use, academic or commercial.

- Developer Documents (added in this budget period):
  1. A finite element analysis workflow - A broad workflow used for Open Knee(s) modeling & simulation.  
<https://simtk.org/websvn/wsvn/openknee/doc/FEA-workflow.pdf>  
Last Update: Nov 24, 2015
  2. Anatomy of finite element analysis - Description of components of Open Knee(s) modeling & simulation.  
[https://simtk.org/websvn/wsvn/openknee/doc/msm\\_2015.pdf](https://simtk.org/websvn/wsvn/openknee/doc/msm_2015.pdf)  
Last Update: Nov 24, 2015
  3. Specifications: Pressure Sensor Calibration - Wiki page summarizing procedures to calibrate contact pressure sensors for patellofemoral joint testing.  
<http://wiki.simtk.org/openknee/Specifications/PressureCalibration>  
Last Update: Apr 14, 2016
  4. Specifications: Pressure Analysis - Wiki page summarizing procedures to process raw contact pressure data obtained for patellofemoral joint testing.  
<http://wiki.simtk.org/openknee/Specifications/PressureAnalysis>  
Last Update: Apr 14, 2016
  5. Specifications: Image Segmentation - Wiki page summarizing procedures to reconstruct tissue volumes from anatomical images.  
<http://wiki.simtk.org/openknee/Specifications/ImageSegmentation>  
Last Update: Apr 14, 2016
  6. Specifications: Geometry Generation  
<http://wiki.simtk.org/openknee/Specifications/GeometryGeneration>  
Last Update: Apr 14, 2016
- User Documents (added in this budget period):
  1. Community Outreach: Cleveland Clinic, Cleveland, Ohio, USA - Presentation on Open Knee(s) history, motivation, and progress.  
[https://simtk.org/websvn/wsvn/openknee/doc/ccf-orc\\_2015.pdf](https://simtk.org/websvn/wsvn/openknee/doc/ccf-orc_2015.pdf)

Last Update: Nov 24, 2015

2. Community Outreach: University of Eastern Finland, Kuopio, Finland - Presentation on Open Knee(s) history, motivation, and progress.

[https://simtk.org/websvn/wsvn/openknee/doc/uef\\_2015.pdf](https://simtk.org/websvn/wsvn/openknee/doc/uef_2015.pdf)

Last Update: Nov 24, 2015

3. Community Outreach: University of Missouri, Columbia, Missouri, USA - Presentation on Open Knee(s) history, motivation, and progress.

[https://simtk.org/svn/openknee/doc/mizzou\\_2015.pdf](https://simtk.org/svn/openknee/doc/mizzou_2015.pdf)

Last Update: Apr 17, 2015

The team follows an open science approach; many project activities can be viewed publicly in the development wiki at <http://wiki.simtk.org/openknee>. All such information is disseminated using the Creative Commons Attribution-ShareAlike 3.0 Unported (CC BY-SA 3.0) license, see <http://creativecommons.org/licenses/by-sa/3.0/>). Significant wiki pages are listed below.

1. Specifications – Wiki page listing all specifications under development including those related to specimen preparation, anatomical imaging of the knees, mechanical testing of the tibiofemoral and patellofemoral joints, and individual tissues, and different components of modeling and simulation steps. This documentation illustrates the steps in building computational models of musculoskeletal joints. In this regard, these specifications can enable others' to implement modeling and simulation procedures and can be used for training of engineers:

<http://wiki.simtk.org/openknee/Specifications>

2. Recurring Meetings – Minutes of meetings between team members and collaborators:

<http://wiki.simtk.org/openknee/RecurringMeetings>

3. Specimen information – Wiki pages relevant to characteristics of acquired and tested knee specimens:

- <http://wiki.simtk.org/openknee/oks001>
- <http://wiki.simtk.org/openknee/oks002>
- <http://wiki.simtk.org/openknee/oks003>
- <http://wiki.simtk.org/openknee/oks004>
- <http://wiki.simtk.org/openknee/oks005>
- <http://wiki.simtk.org/openknee/oks006>
- <http://wiki.simtk.org/openknee/oks007>
- <http://wiki.simtk.org/openknee/oks008>
- <http://wiki.simtk.org/openknee/oks009>

4. Specifications for activities by collaborating teams at the University of Utah and at Stanford University:

- FEBio Features – Wiki page providing specifications for features to be implemented in FEBio, a publicly accessible software package for finite element analysis in biomechanics. Many features have been implemented, testing and dissemination are in progress.

<http://wiki.simtk.org/openknee/Specifications/FebioFeatures>

- Cloud Computing Prototype – Wiki page providing specifications to extend capabilities of Simtk.org by implementing a cloud computing prototype. A working prototype including a results retrieval interface has been built; launch is expected with the release of the upgraded SimTk infrastructure.

<http://wiki.simtk.org/openknee/Specifications/CloudComputingPrototype>

5. Cases – Wiki page providing a list of case studies (under development or published) to illustrate the utility of Open Knee(s) models & data.

<http://wiki.simtk.org/openknee/Cases>

6. KneeProjects – Wiki page listing various projects providing knee related models and data that may be of use for Open Knee(s) users and for anyone who may be interested in modeling and simulation of the knee joint.

<http://wiki.simtk.org/openknee/KneeProjects>

Editorial articles published in the report period related to Open Knee(s) are:

- Miller, K. (2016) Simtk relaunch: back at the cutting edge, Biomedical Computation Review (Spring 2016), published by Simbios, the NIH National Center for Physics-Based Simulation of Biological Structures.

Peer-reviewed conference abstracts presented during the report period are:

- Gad, O. M., Bennetts, C. J., Chokhandre, S. and Erdemir, A. Open Knee(s): the role of the transverse ligament in cartilage and menisci mechanics predicted by finite element analysis of the knee, Research Experiences for Undergraduates Symposium, October 25-26, 2015, Arlington, VA.
- Colbrunn, R. W., Bonner, T. F., Chokhandre, S. K., Bennetts, C. J., Halloran, J. and Erdemir, A. Open Knee(s): comprehensive patellofemoral joint testing for specimen-specific next generation knee models, 39th Annual Meeting of the American Society of Biomechanics, August 5-8, 2015, Columbus, OH.
- Bennetts, C., Chokhandre, S., Donnola, S., Flask, C., Bonner, T., Colbrunn, R. and Erdemir, A. Open Knee(s): magnetic resonance imaging for specimen-specific next generation knee models, Summer Biomechanics, Bioengineering, and Biotransport Conference, June 17-20, 2015, Snowbird, UT.
- Bonner, T. F., Colbrunn, R. W., Chokhandre, S., Bennetts, C. and Erdemir, A. Open Knee(s): comprehensive tibiofemoral joint testing for specimen-specific next generation knee models, Summer Biomechanics, Bioengineering, and Biotransport Conference, June 17-20, 2015, Snowbird, UT.
- Maas, S., Erdemir, A., Halloran, J. P. and Weiss, J. A. Computational framework for application of residual stress when the stress-free configuration is unknown, Summer Biomechanics, Bioengineering, and Biotransport Conference, June 17-20, 2015, Snowbird, UT.
- Erdemir, A., Bennetts, C., Bonner, T., Chokhandre, S. and Colbrunn, R. Open Knee(s): founding data for next generation knee models, 2015 Biomedical Engineering Society / Food and Drug Administration Frontiers in Medical Devices Conference: Innovations in Modeling and Simulation, May 18-20, 2015, Washington, DC.