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/projects/openknee. The information is disseminated using the Creative Commons Attribution 4.0 International License (https://creativecommons.org/licenses/by/4.0/). 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. Specifications: Mesh Generation - Wiki page summarizing procedures to create finite element mesh of a geometry of interest with node, element, node set, element set and surface set definitions.

       https://simtk.org/plugins/moinmoin/openknee/Specifications/MeshGeneration
    2. Specifications: Template Model Generation – Wiki page summarizing procedures to assemble a template model with place holders for material, boundary conditions, and other features.

       https://simtk.org/plugins/moinmoin/openknee/Specifications/TemplateModelGeneration
    3. Specifications: Model Customization – Wiki page summarizing procedures to customize the template model for analysis in simulation software FEBio.

       https://simtk.org/plugins/moinmoin/openknee/Specifications/ModelCustomization
    4. Specifications: Modeling Constitutive - Wiki page summarizing coefficients of constitutive models for various components of the knee.

       https://simtk.org/plugins/moinmoin/openknee/Specifications/ModelingConstitutive
    5. Specifications: Modeling Kinematics Kinetics – Wiki page summarizing procedures and Python scripts to access joint mechanical testing data files, extracting information in image coordinate system as input and validation data for finite element analysis.

       https://simtk.org/plugins/moinmoin/openknee/Specifications/ModelingKinematicsKinetics

- Community Outreach (added in this budget period):
    1. Ahmet Erdemir provided lectures to promote modeling and simulation biomechanics, which are relevant to Open Knee(s) activities: Erdemir, A., Democratization of modeling & simulation in biomechanics: our experience with Open Knee(s), October 26, 2017, Kinesiology Colloquium, Department of Kinesiology, Pennsylvania State University, University Park, PA.

       https://simtk.org/svn/openknee/doc/psu_2017.pdf

The team follows an open science approach; many project activities can be viewed publicly in the development wiki at https://simtk.org/plugins/moinmoin/openknee/. All such information is disseminated using the Creative Commons Attribution 4.0 International License, see https://creativecommons.org/licenses/by/4.0/). 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:

   https://simtk.org/plugins/moinmoin/openknee/Specifications
2. Recurring Meetings – Minutes of meetings between team members and collaborators:

   https://simtk.org/plugins/moinmoin/openknee/RecurringMeetings
3. Specimen information – Wiki pages relevant to characteristics of acquired and tested knee specimens:
   - https://simtk.org/plugins/moinmoin/openknee/oks001
   - https://simtk.org/plugins/moinmoin/openknee/oks002
   - https://simtk.org/plugins/moinmoin/openknee/oks003
   - https://simtk.org/plugins/moinmoin/openknee/oks004
   - https://simtk.org/plugins/moinmoin/openknee/oks005
   - https://simtk.org/plugins/moinmoin/openknee/oks006
   - https://simtk.org/plugins/moinmoin/openknee/oks007
   - https://simtk.org/plugins/moinmoin/openknee/oks008
   - https://simtk.org/plugins/moinmoin/openknee/oks009
   - https://simtk.org/plugins/moinmoin/openknee/oks010
   - https://simtk.org/plugins/moinmoin/openknee/oks011
   - https://simtk.org/plugins/moinmoin/openknee/oks012
   - https://simtk.org/plugins/moinmoin/openknee/oks013
   - https://simtk.org/plugins/moinmoin/openknee/oks014
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   - https://simtk.org/plugins/moinmoin/openknee/oks020
   - https://simtk.org/plugins/moinmoin/openknee/oks021
   - https://simtk.org/plugins/moinmoin/openknee/oks022
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 were implemented, testing and dissemination were performed.

     https://simtk.org/plugins/moinmoin/openknee/Specifications/FebioFeatures
   - Cloud Computing Prototype – Wiki page providing specifications to extend capabilities of SimTK by implementing a cloud computing prototype. A working prototype including a results retrieval interface was built and launched.

     https://simtk.org/plugins/moinmoin/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 and data.

   https://simtk.org/plugins/moinmoin/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.

   https://simtk.org/plugins/moinmoin/openknee/KneeProjects

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

- Chokhandre, S. K. and Erdemir, A. A comprehensive testing suite for mechanical characterization of articular cartilage with documented repeatability, 42nd Annual Meeting of the American Society of Biomechanics, August 8-11, 2018, Rochester, MN.
- Nagle, T., Erdemir, A., Gillespie, C. and Colbrunn, R. A novel strategy for determination of a functional knee joint coordinate system, 8th World Congress of Biomechanics, July 8-12, 2018, Dublin, Ireland.
- Landis, B. and Erdemir, A. Automation of volumetric mesh generation, mesh assembly and model input from surface representations of tissue structures, 41st Annual Meeting of the American Society of Biomechanics, August 8-11, 2017, Boulder, CO.
- Malik, R. and Erdemir, A. Automated optical thickness measurement system, 2017 Summer Biomechanics, Bioengineering, and Biotransport Conference, June 21-24, 2017, Tucson, AZ.
- Erdemir, A., Bonner, T., Chokhandre, S., Colbrunn, R., Landis, B., Morrill, E., Owings, T. and Schimmoeller, T. Logistics of building virtual specimens for in silico biomechanics, 2017 Biomedical Engineering Society / Food and Drug Administration Frontiers in Medical Devices Conference: Innovations in Modeling and Simulation, May 16-18, 2017, Washington, DC.