

(1) Major activities.

The budget period for this report was 09/21/2017 – 06/30/2018. In this budget year, major activities of the project primarily focused on administrative activities to mobilize the collaborating teams (4 national, 1 international). In following, the teams involved in efforts to establish consensus on the detailed workflow of the project and to start modeling and simulation activities along with community outreach.

(2) Specific objectives.

The overall goal of the project is to understand how modelers' choices to build models, even when using the same data, may influence predictions and therefore the reproducibility of simulation results. Specific aims are i) to quantify the influence of variations in modeling and simulation workflows on the reproducibility of joint level predictions in computational knee biomechanics, and ii) to quantify the influence of variations in modeling and simulation workflows on the reproducibility of tissue level predictions in computational knee biomechanics.

The primary aim of the reporting period was the organization of five collaborating teams – Cleveland Clinic, Cleveland State University, University of Denver, Auckland Bioengineering Institute, Hospital for Special Surgery; administratively, contractually, and from a scientific workforce perspective. Specific to the modeling and simulation activities, the goals were to decide on the specific data sets to utilize from existing data resources and to start model development activities.

(3) Significant results, including major findings, developments, or conclusions.

Administratively, all subcontracts were setup, albeit in a delayed manner, and teams have started recruiting research fellows, graduate students, and engineers. Online infrastructure for collaboration and outreach has been maintained [1]. Collaborating teams had a site visit at the Cleveland Clinic to start the project and have multiple meetings, some web-based and one during the annual meeting of the Orthopaedic Research Society (ORS). The exact nature of modeling and simulation phases and the timeline were decided: model development, model calibration, model benchmarking, and model reuse. Specimens from data resources were also agreed upon: oks003 from Open Knee(s) and DU02 from Natural Knee Data. Instructions on the model development phase were disseminated to each team and the public on the project wiki [2]. Currently, the teams are at the model development phase. Data earmarked for the model development phase were also disseminated publicly at the project site for the teams to utilize [1]. The investigators also reached out to the third-party reviewer, Tina Morrison from US Food and Drug Administration, to explain project deliverables for credibility and reproducibility assessment and the teams' expectations from the comparative analysis. Community outreach has been evolving organically; the investigators delivered a group presentation at the Cleveland Clinic on the "art" of computational modeling in knee biomechanics. At the ORS 2018 annual meeting, team leaders engaged with scientists of knee biomechanics and of reproducibility in science. The teams are

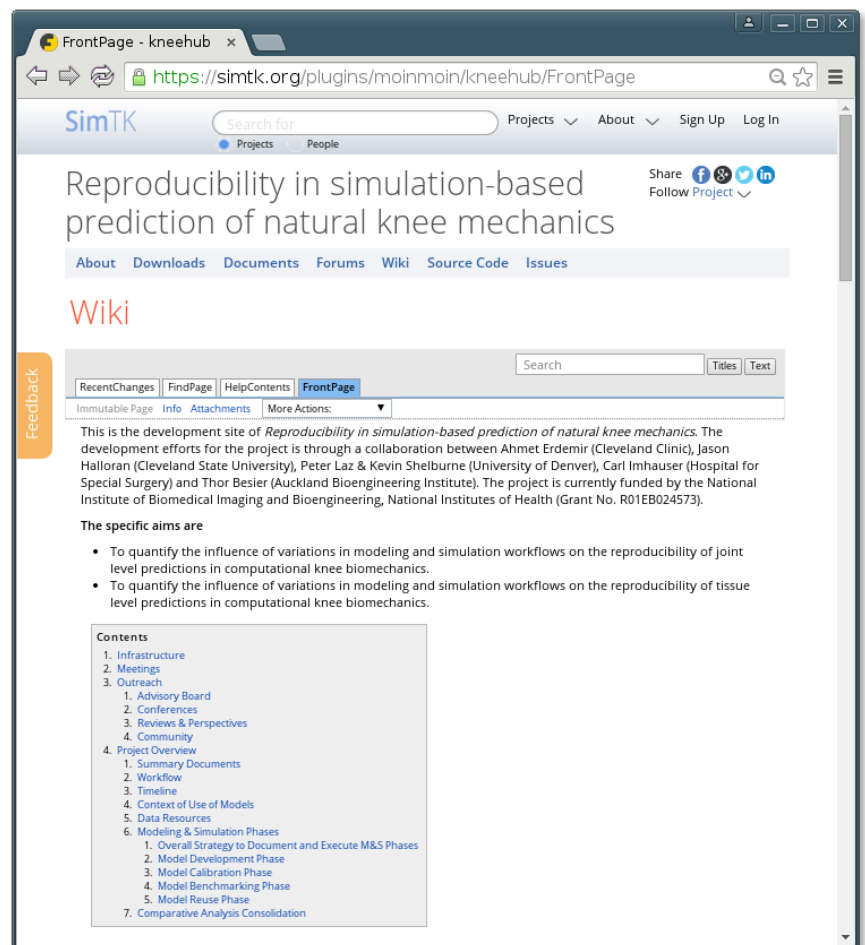


Figure 1. Project wiki provides the gateway for collaborating teams and the public access to information on project phases [2].

tentatively planning to have a scientific workshop at ORS 2019. They are also in the process of writing a manuscript on modeling and simulation workflows in knee biomechanics.

(4) Key outcomes or other achievements.

The project website is fully operational [1]. The wiki provides a gateway for the collaborating teams and the public to get instructions on project phases and links to data resources and in future, modeling and simulation specifications and outputs [2] (Figure 1). Dissemination of data earmarked for modeling phases has already started in the “Downloads” section of the project site [1].

The modeling teams, along with the third-party reviewer, presented a study on comparison of the project workflow to broadly applicable guidance on credible practice of modeling and simulation [3]. To promote the project in the European community, an abstract was submitted to VPH 2018, Virtual Physiological Human Conference to be held in Zaragoza in September 2018. The Principal Investigator has also been involved in synergistic scholarly activities; on opinions on model sharing and reproducibility in the biomechanics community [4] and on credibility of simulation in neurosciences [5].

References

- [1] Project website @ SimTK: Reproducibility in simulation-based prediction of natural knee mechanics: Project Home, <https://simtk.org/projects/kneehub>. Accessed on May 8, 2018.
- [2] Project wiki @ FrontPage – kneehub, <https://simtk.org/plugins/moinmoin/kneehub/>. Accessed on May 8, 2018.
- [3] Erdemir, A., Besier, T. F., Imhauser, C. W., Laz, P., Morrison, T., Shelburne, K. and Halloran, J. P.. A collaborative pathway to establish credible practice of modeling and simulation in knee biomechanics in conformance with community recommendations. 2018 IMAG Futures Meeting – Moving Forward with the MSM Consortium, March 21-22, 2018, Bethesda, MD.
- [4] Erdemir, A., Hunter, P. J., Holzapfel, G. A., Loew, L. M., Middleton, J., Jacobs, C. R., Nithiarasu, P., Lohner, R., Wei, G., Winkelstein, B. A., Barocas, V. H., Guilak, F., Ku, J., Hicks, J. L., Delp, S., Sacks, M., Weiss, J. A., Ateshian, D. G. A., Maas, S. A., McCulloch, A. D. and Peng, G. C. Y. (2018) Perspectives on sharing models and related resources in computational biomechanics research, *Journal of Biomechanical Engineering*, 140, 024701.
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