

PROJECT SUMMARY

For centuries, knowledge has evolved by words of mouth, journals and books. This approach is effective when a discipline is young, but is not scalable when the discipline grows up. When the number of journals and books in a discipline becomes large, we divide the discipline into subdisciplines, or declare that the discipline is mature, only to be surprised by yet another breakthrough drawing upon several subdisciplines. This approach has made it hard for individuals to master and contribute to the discipline, a barrier that has discouraged many young people to enter traditional disciplines of science and engineering.

We envision a new approach to evolving knowledge in a traditional discipline, leveraging existing and emerging cyberinfrastructure. Specifically, we will develop a prototype of an online platform, called iMechanica.Org (or iMech for short), with the mission to evolve all knowledge within Applied Mechanics. For any such a discipline with deep academic roots and broad industrial user base, the mission to evolve all its knowledge can only be accomplished if many people collaborate.

While the mission of iMech is ambitious, this Demonstration Project will focus on the following deliverables, integrating functions that are crucial to rallying many people to evolve knowledge of the discipline, in all its intricacy, depth and breadth. First, we will develop community-building tools including a weblog of news and views maintained for and by the international community of Applied Mechanics, a social network aiming to link all past and living mechanics, and an interactive website for hands-on projects involving mechanical principles designed for and by K-12 teachers and students. Second, we will integrate knowledge-processing tools including an archive for users to upload data and images, a wiki for collaborative synthesis of knowledge, and a new kind of research journal that enhances conventional functions of journals such as archiving, filtering and commenting, and enables new functions such as wikiediting and social bookmarking. To demonstrate the use of the wiki in synthesizing knowledge at an advanced level, we will involve students and practitioners in industry to write a wikibook on Thin Film Fracture Mechanics, and will use the writing process as a part of a graduate course taught at Harvard, with webcast to the University of Nebraska where students will also take the course for credit.

Intellectual merit. The intellectual merit of this proposal is twofold. First, we will demonstrate a platform that will make published knowledge constantly evolve and new ideas rapidly spread. In steady state, the discipline and its online platform will co-evolve. Second, we will demonstrate a process to evolve knowledge by massive collaboration. The need to leverage the new cyberinfrastructure to evolve knowledge exists in all traditional disciplines. The platform developed for Applied Mechanics and experience gained should be replicable to other disciplines. More broadly, in a time when nearly everyone subscribes to interdisciplinary research and education, it has become increasingly important to evolve each individual discipline online, making specialized knowledge generally accessible and useful. As individual disciplines evolve their own knowledge, platforms of different disciplines will be hyperlinked, growing into an organic structure.

Broad impact. This approach will (1) substantially expand the character of education and research by providing a live environment embodying all knowledge in a discipline – from phenomena and explanations of interest to the general public, to textbooks and demonstrations for students, to data and tools used by practitioners in industries, and to theories and experiments pursued by academics; (2) prepare a new generation of experts capable of using cyberinfrastructure throughout their lives to learn and teach; and (3) enable K-12 teachers and students to actively participate in science and engineering.