students learn to work collaboratively on interdisciplinary problems. Students and postdocs are of course involved in preparing research articles, are sent to conferences and workshops, and participate actively in meetings with visitors to the university.

E Timeline

The proposed timeline for this project is the following:

Year	1	2	3	4	5
Research Tasks	C.1.1, C.2.1	C.1.1, C.1.2, C.2.1, C.2.3	C.1.2, C.2.1, C.2.3, C.3.1	C.2.2, C.3.1 C.3.2 (scenario a)	C.3.2 (scenarios b,c)

F Broader impact

The toolkit in this proposal provides the solution to a problem that is common to health, industrial and homeland security applications, as outlined in in Sec. A. This makes it an attractive technology with chances to be incorporated into commercial codes, and in this way have broad societal impact. The PI is involved in two national centers at Stanford, the Army High Performance Computing Research Center and the NIH Center for Biocomputation. Both have as one of their core missions to deliver and provide software that can be adopted by: a) investigators at the army laboratories for the former and, b) by the broader community working on scientific biological problems for the latter. Both communities will be utterly interested in software implementing the ideas herein, and the PI is committed to make it available through a documented code with test cases and examples at the publicly available web-based repository *http://simbios.stanford.edu* of the NIH center. In the context of these other projects, the IBM will be applied to challenging problems in biomechanics and homeland security, so as to provide a convincing argument for the community to consider its adoption, and will be proactively promoted by the PI and his students. Additionally, an explicit effort will be made to make the results of the study of the mechanical behavior of fluid-driven cracks available to naval engineers at the office of naval research, which currently has a number of concurrent projects on the simulation of implosive failure of underwater structures. A similar effort will be made to reach out to the oil and gas industry, who is actively building its tools for reservoir simulation. Finally, through the outlined educational activities roughly 30,000 middle school students in the bay area may adopt a positive perspective about a career in science, not counting those affected after the end of this project but exposed to the teachers trained within it.

G Results from prior NSF support

PHY-0425897: "NSEC: Center for Probing the Nanoscale", 09/01/04-08/31/07, $255,000. The author of this proposal is a co–investigator in this project. This is an NSF center for nanotechnology, focused on the creation and advancement of probing technologies for the nanoscale, such as atomic (AFM) and magnetic (MFM) force microscopes. The funding is allocated or renewed to investigators on an annual basis. As part of this project two graduate students, Haneesh Kesari and Kedar Kale, have being supported under the supervision of Prof. Lew at different times. In collaboration with an experimental group at Stanford, Prof. Lew is working on modeling and simulating the dynamics of an AFM. The objective is to take advantage of recent advances in probe design that now allow for the time–resolved measurement of the motion of an AFM, to learn more about the sample, for example, by using it to measure highly localized mechanical properties. In this context, we have created a new class of parallel multi–time step integrators to simultaneously resolve the length scales of the AFM cantilever and the atomically sharp AFM tip. One journal paper has already been published [131], and another one is in preparation.