Project Abstract/Summary

The fundamental problem of robotics is how to design and deploy general purpose mechanisms capable of performing user-specified mechanical work within a designated task domain. This statement reveals the three essential challenges to any agenda for such a science of programmable energy exchange: **architecture** (a theory and practice of design and deployment); **environment** (a rational framework for task domain models); and **language** (a formalism for user specification). The **architectural** problem is to formulate a user's goal in terms of target energy landscapes intended to govern the coupled agent-environment pairing, yet to do so in a *compositional* manner. The resources available for engaging the **environment** are revealed by interpreting at the mesoscale advances in the thermodynamics of information applied to heat engines equipped with feedback loops. Finally, a recent convergence between the computer scientists and mathematicians working at the logical foundations of mathematics affords a new body of tools and techniques that can render the topological symbols of dynamical systems theory as typed expressions in a programming **language**. The project aims to produce a novel, correct, automated design environment for building robots with unparalleled capabilities along with a new generation of unusually interdisciplinary young scholars, all through the effort to stand up a new discipline on sound mathematical and physical foundations.