**Project Title: SHULGI: A Geosimulation Tool For Modeling Human Movement and Interactions**

**Project PIs**:  Dr. Mark Altaweel and Dr. Scott Branting

Summary of Project:

This project seeks to develop a simulation tool that can be used to study transportation-related questions using an agent-based simulation tool. The anticipated tool attempts to integrate numerous levels of analysis (e.g. GIS, network analysis, and statistical study), capabilities for large-scale computing, and make a user-friendly environment that can allow numerous researchers to conduct simulations for large and small-scale problems. The tool attempts to facilitate theoretical testing and understanding of transportation, with the tool designed to be flexible to alternative theoretical approaches and perspectives. In addition, the tool will have functionality allowing users to integrate numerous existing models and tools, allowing the user to leverage existing work. We have chosen several datasets that will be used to test the tools capabilities. The first test case is from Kerkenes Dag, an ancient settlement in modern day Turkey. This site is currently being excavated and researched by Dr. Branting.

Summary of Project from February 2007 to June 2007:

After receiving official notice of the project's funding, we proceeded to search for student candidates to work on the project. The University hired two students (Robert Tate and Joshua Trampier) to work on GIS data related to the project. In addition, a University student, Zulfi Imani, was hired to be a programmer on the project. At ANL, two student hires from IIT, Rangamani Srikrishnan and Yanwei Wu, were made to assist with software development.

   After the hires were made at ANL in mid-February, we had to wait until late April to begin development of SHULGI. The main reason for this is due to the fact that the two ANL hires were foreign nationals from sensitive countries, which considerably delayed their start date of work. Dr. Altaweel, during that time, did begin some initial groundwork on creating the simulation tool and developed useful RepatSimphony components, which are used for SHULGI's functionality. Since late April, Dr. Altaweel and his student hires have been creating specific components and functionality within the SHULGI tool, which will be discussed in further detail below. At the University, there was considerable delay in getting funds because all of the project funds were placed in an LDRD grant. Therefore, funds had to be transferred from ANL, and the accounting procedures have delayed some of the University's efforts. In fact, the transfer of funds from ANL to UC was not cleared until late May, more than two months after the request for transfer of funds to UC were made.

   In May, Dr. Branting left for Turkey, and he began the data collection as specified by the grant proposal. We anticipate that Dr. Branting will finish collecting the samples soon and process the data within the next month. Dr. Branting's student hires have been

assisting Dr. Altaweel with coordination of the project's data and making sure the SHULGI tool develops appropriately for the scientific domain. Prior to leaving, Dr. Branting created a work list of tasks that need to be accomplished by the end of the grant cycle. In addition, Dr. Branting provided the processed data used for initial simulation cases.

Summary of the Current State of the SHULGI Simulation Tool:

In April, software development of SHULGI commenced. The project began by creating appropriate mechanisms to read the project's data. This included creating algorithms for interpolating some of the data used in the work. All of the movement, decision, and biometric algorithms used in the preliminary simulations were incorporated within the tool. In addition, a user interface was created, which allows for a point and click form of modeling. Different analysis tools, including GIS, network analysis, and statistical functionality, were incorporated as part of SHULGI's simulation suite. Overall, there are over 60 object classes currently incorporated in SHULGI. We have been conducting verification and validation of modeling procedure continuously throughout each phase of the project.

　　At present, we have begun running preliminary simulations and analyzing results. The goal of this phase of development is to replicate Dr. Branting's results from his dissertation work. This will help us validate and test the efficacy of the approach and models used in the project. We are also experimenting with different data outputs in order to assist with data analysis and display. We plan to use alternative datasets from Thailand and other locations in the near future. The University students are assisting with data issues and questions as they develop.

　　By the end of September, we anticipate that we will have a preliminary tool that can run many different types of spatial simulations that relate to transportation. At that time, we should have incorporated a number of data analysis and output capabilities that can be offered to the user. We also anticipate that the tool will be fairly easy to use, with users not required to know any programming language. If there is sufficient time before the end of September, at which time all funds from ANL disappear due to the LDRD restrictions, then we would like to begin to test the tool on large-scale computational problems dealing with large urban settings and traffic volumes. We hope that by September SHULGI will be on its way to becoming among the most user-friendly agent-based transportation simulation tools currently employed anywhere. Users will be able to add new behaviors as well as test different theoretical questions through a simple interface. This will make SHULGI applicable to numerous transportation-related questions and theoretical understanding for small or large-scale problems.

Publication, Conference Attendance, and Future Funding:

We hope to publish our preliminary research and simulations. By the end of September, SHULGI should be at a point were it can be used to answer relevant research questions. All of the initial testing, verification, and validation will have been completed by this time, allowing SHULGI to be used for simulations that can be published. We are developing SHULGI to be an open source project, enabling this tool to be easily

transmittable to others for scientific testing and review. We anticipate putting one or two journal articles (perhaps one geography and one simulation journal) after the completion of the initial development. We also anticipate participating in the Agent2007 conference that is hosted by the University and ANL. We have signed up for this conference and we plan to make a joint presentation in this conference.

We hope to find potential collaborators and partners, in either the Agent2007 conference or other settings, to assist in finding funds to continue SHULGI's development. There will be tool development issues we will not be able to address by September, due to funding and time restrictions. For instance, we do not anticipate having sufficient resources and time to integrate facilities that will allow native models written in different computer languages to be easily integrated in SHULGI. By September, however, it should clear which grants and other funding resources may be available in order to assist future development. Dr. Altaweel is already planning to submit two NSF grants (under the Coupled Natural and Human Systems program and the International Polar Year) that would propose using SHULGI. We also hope to find grants that we can jointly submit to.