

# Parallel Computation using GPGPU to Simulate Crowd Evacuation Behaviors - planning effective evacuation guidance at emergencies -

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**Abstract.** We propose parallel computing to simulate crowd evacuation behavior. It allows evacuation of ten thousands of agents to be simulated faster than does the existing system. Our prototype system consists of a new traffic simulator and scenario generator. The traffic simulation system uses a general purpose graphics processing unit (GPGPU) and simulates the agents' movements in a three-dimensional map. Our proposal enables realistic evacuation simulations and provides a platform that widens the applications of RoboCup Rescue Simulation to, for example, crowd evacuation from buildings. The evacuation simulations help security offices to prepare manuals for emergencies.

## 1 Introduction

The RoboCup Rescue Simulation (RCRS) system was designed in 1998 and the Rescue Simulation league started using its version 0 system [4]. The objectives of RoboCup Rescue Project are

- to apply agent technology to social problems and contribute human welfare,
- to provide a practical problem for development of research fields,
- to promote international research collaboration via the project.

RCRS aims to simulate rescue operations and human behaviors in disaster situations over an area of a few km<sup>2</sup> considering the number of people and facilities that exist in the area. The simulation results will be put to practical use during disasters and even before a disasters occurs.

It has been recognized that there are issues related to achieving the objectives that were set at the beginning of the RoboCup Rescue project [8]; that is it cannot simulate the behavior of a large number of agents or behaviors inside buildings. They are key issues for rescue simulation systems to model realistic disasters. Daidaitoku project tried to solve these issues [9]. The project aimed to simulate the evacuation of 10,000 people and operations to rescue them from a real 4km<sup>2</sup> area. Their system divided the large area into small areas. The size