



Hermes – Investigation of an evacuation assistant for use in emergencies during large-scale public events, based on cluster software and support from ParTec and Blade Servers from Dell.

As part of the German Government's high-tech strategy, the Federal Ministry of Education and Research (BMBF) has launched a program on "Research for Civil Security". The field of "Protecting and Saving Human Life" in this program includes funding for the Hermes project. The Jülich Supercomputing Centre (JSC) at the Forschungszentrum Jülich is coordinator of this project. Project partners are:

- University of Wuppertal, Civil Engineering Department, Chair for Construction Materials Technology and Fire Protection, Wuppertal,
- Imtech Deutschland GmbH & Co. KG, Hamburg
- Multifunktionsarena Immobiliengesellschaft mbH & Co. KG (ESPRIT arena), Düsseldorf
- PTV Planung Transport Verkehr AG, Karlsruhe
- TraffGO HT GmbH, Duisburg
- University of Bonn, Geographic Institute, Bonn
- Cologne University, Institute for Theoretical Physics, Cologne
- Vitracom AG, Karlsruhe
- Düsseldorf Fire Brigade and Düsseldorf Police Headquarters
- North Rhine-Westphalia State Office for Central Police Services, Neuss
- Special Security Service SSSD GmbH, Bergheim

The trend toward large, multi-functional building structures in combination with a wide range of large-scale public events presents new challenges for the quality of security concepts. In an emergency, everyone present must be able to leave the danger zone within a building or fenced area quickly. The Hermes collaborative project aims to improve personal safety during emergencies through the use of an evacuation assistant.

Project description and goals

The collaborative Hermes project aims to improve safety for people in large multifunctional buildings and also at big events by exploring the effectiveness of an evacuation assistant. This assistant predicts bottlenecks in advance in order to help decision-makers (operators, security services, police and firefighters) assessing conditions

correctly, thereby enabling the optimal use of security personnel and rescue forces. In addition, it offers the ability to analyze potentially dangerous situations prior to the events. The preparation of appropriate emergency plans or the specifically targeted training of security forces can help to meet the challenges that such situations present. The evacuation assistant system will be tested in the ESPRIT arena in Düsseldorf (max. 66,000 spectators) in 2011.



Figure 1: Visitors in a public multifunctional arena (source: ESPRIT arena)

Innovations and applications

Coupling the simulation core to the safety and security management system and counting people by means of automated image processing will make it possible to obtain simulation results pertaining to actual danger conditions for the first time. Using the available data about the distribution of people and the availability of rescue routes, a parallel computer will generate a faster-than-real-time simulation to predict the movement of all people present during the next 15 minutes and update it at one-minute intervals, thereby providing immediate simulation results for crowd management. A communication module will provide necessary and up-to-date information to the emergency teams on site. In order to optimize the underlying models of pedestrian dynamics, researchers will conduct comprehensive field studies and laboratory tests that will make it possible to validate the construction and planning regulations, which

are currently somewhat contradictory. In addition, the research project will be complemented by an investigation of the user requirements and by an accompanying socio-scientific study.

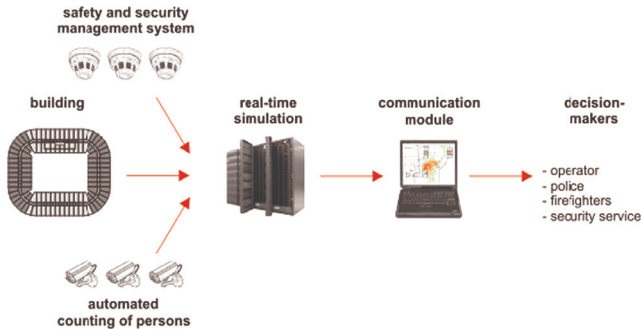


Figure 2: Schematic diagram of the evacuation assistant (source: Hermes)

A series of experiments were already carried out in cooperation with the University of Wuppertal and the ESPRIT arena with up to 300 students (see figure 3). The results of these experiments will be used to calibrate and validate the models for pedestrian dynamics that are currently being developed for the evacuation assistant by JSC and the University of Cologne. With these data, it will be possible for the first time to measure characteristics of staircases and other complex geometries based on the trajectories of the test persons. In the next step, JSC will implement the validated pedestrian dynamics models on state-of-art parallel systems such as the Cell Broadband Engine in order to achieve real-time simulations for a reliable forecast of the evacuation dynamics.



Figure 3: Arena with 300 students leaving through one exit (source: Hermes)

Hard- and Software computing solution from ParTec and Dell



The Forschungszentrum Jülich and the project consortium decided to use Dell Cluster hardware and software and support from ParTec Cluster Competence Center GmbH. 26 Dell M610 Blade Servers with two Intel Xeon X5670 CPUs each in two Dell Blade Chassis (M1000e), QDR Mezzanine

HCAs from Mellanox and an Infiniband switch from QLogic help to cope with the computing requirements of such simulations and reduce energy as well as cooling costs by as much as 20 %.

ParTec Cluster Competence Center GmbH, played, and continues to play, a vital role in the provisioning and day-to-day operation of the Hermes Blade cluster. Key parts of the installation were carried out using ParTec’s ClusterTools suite named ParaStation, which provided installation configuration management and update management in a most effective way. The monitoring facility ParaStation GridMonitor reports irregularities of the system in a timely manner and enables administrators to take the appropriate steps to keep the system up and running and maintain the users’ productivity.

The ParaStationV5 cluster suite works seamlessly with the Dell Blade hardware setup and hides the complexity, providing powerful yet easy commands for the control of the blades and the chassis. This makes administration very simple, covering all aspects from gathering blade information for the initial installation to re-installation after hardware repairs. Keeping the software in sync within the cluster is also a task made easy via the ParaStationV5 cluster suite.

In the science of simulating pedestrian movement, ParTec could help with the ParaStation MPI which adds to the performance by providing efficient and powerful process management. This gives the applications the necessary performance to be up to the challenges of the field and every second counts in an emergency forecast.

“We are proud that ParTec was chosen by the Forschungszentrum Jülich to contribute with ParaStationV5 cluster suite to the onsite and remote management of the supercomputer cluster Hermes,” said Hugo R. Falter, Chief Operating Officer of ParTec Cluster Competence Center, GmbH.

The success of this project based on a co-operation with ParTec shows how important it is to listen to customer needs to find a consolidated solution that meets the exact requirements of the customer. The solution delivered to Forschungszentrum Jülich demonstrates our commitment to customers and partners, says Dieter Schütt, Solution Consultant HPC, Dell.

“Thanks to a truly high performance computing solution, we can now predict pedestrian behavior up to 15 minutes into the future. This allows us to give the event organizers the time to act responsibly and ensure a smooth and safe operation of the event”, said Armin Seyfried, the project leader at Forschungszentrum Jülich.

Thus, just as demonstrated with JuRoPA and Judge, ParTec’s high performance cluster software once more helps to meet the targets in demanding and ambitious environments and plays a significantly role in protecting and saving human life.