

Coalmine fire evacuation simulation & modelling



Virtual human crowds have been used in the simulation of building and airplane evacuations but not yet for the simulation of an underground coal mine fire. Dr Jinsheng Kang from Brunel University used a Global Research Award from The Royal Academy of Engineering to develop an evacuation model.

Dr Kang, with Professor Norman Badler and his team at Center for Human Modeling and Simulation, University of Pennsylvania:

- simulated the underground coal mine virtual environment,
- created a fire and smoke propagation model, and
- created a human physiology and behaviour model under the framework of HiDAC + MACES + CAROSA, and realised real-time simulation.



Simulation of a working shift in a coal mine

A continuous mining model environment was established, including placement of equipment and machinery. Air flow and smoke propagation in tunnels were simulated according to classic mine ventilation network theory. Fire was simulated based on the burning rate, heating value, CO₂ and CO production rates, and a time-variable blower fan to input gas quantity.

Oxygen intake was based on activity type and Basic Metabolic Rate (BMR), with oxygen supply determined by location and content, calculated using the smoke propagation model. The CO₂, CO, visibility and toxicity levels were simulated according to location, which also affected physiological and behavioural responses.

Human behaviour was also an important factor and was simulated according to reported literature, and realized in the CAROSA framework as four types of human crowd activities:

- Aleatoric (Stochastic),
- Reactive,
- Opportunistic and
- Scheduled.

All of these factors were integrated into the framework of HiDAC + MACES + CAROSA,. Currently, the virtual simulation is running on OGRE (the open source rendering engine).

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