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SCIENTISTS LAUNCH WORLD'S MOST ADVANCED CROWD SIMULATION AND EVACUATION SOFTWARE

Scientists at the University of Greenwich have released the next generation of the evacuation and crowd simulation software, buildingEXODUS. Version 5.0 incorporates new capabilities that enable building engineers to perform realistic desk top simulations of people in both normal and emergency conditions.

The software simulates not only how individual people interact with each other and the built environment, but also how they are debilitated by hazards such as heat, smoke and toxic gases. To simulate these complex relationships, the software uses sophisticated rule based systems to control the interaction of five advanced sub models. The software draws extensively on data and experience captured from experiments and real life incidents. For example, the human behaviour submodel includes rules governing the behaviour of people interacting with smoke in fire situations; how people interact with wayfinding signage; and how people select whether to use an escalator or an adjacent stair.

The arrival of this level of sophistication on the desk top means that the building engineer can test more designs in less time to reach the optimal solution, free from costly and unrealistic assumptions.

The new release, Version 5.0, incorporates significant advances in three four key areas:

- **Device Modelling:** Through the introduction of the Transit Node concept, EXODUS is now able to represent movement devices such as Escalators, Travelators and Ticket gates.
- **Enhanced Behavioural Capabilities:** A number of new behavioural capabilities have been included e.g. queuing and existing behavioural capabilities have been enhanced e.g. wayfinding. These include:
    - **Device Behaviours**: Agents can select to use an escalator or adjacent stair and can determine whether they walk or ride an escalator.
    - **Queuing:** Enables the specification of service time delays associated with specific queues. Also allows the shape of the queue to be specified and allows other agents to pass through queues.
    - **Enhanced Signage:** Agent interaction with signs is simulated to represent whether the agent sees the sign and then uses the information available.
    - **Enhanced Itineraries:** A number of new tasks have been introduced to expand the flexibility of the itinerary system, including: group

formation/disbanding, waiting, enhanced delay, agent removal, signage interaction, etc.

    - **Enhanced Social Movement:** Group interaction has been expanded to allow itineraries to be exchanged in the communication process, along with the ability for group members to adapt their speeds to maintain proximity.

- **Software Usability:** Several improvements have been made to the software architecture making it easier to utilise EXODUS features and take advantage of modern hardware capabilities. These include:
    - **EXODUS Script File:** Enable the specification of complex scenario parameters via command line functionality.
    - **64 Bit Implementation:** Both 32 and 64 bit implementations are available enabling very large simulations to be run using the 64 bit implementation.

The sophistication of buildingEXODUS has made it one of the World's leading design tools for simulating evacuation from buildings. Since its launch in October 1996, the package has been used by engineering consultancies, architects, research laboratories, regulatory authorities, police forces, fire brigades and universities in 37 countries: Austria, Australia, Belgium, Brazil, Canada, China, Croatia, Czech Republic, Denmark, Finland, France, Germany, Hong Kong, Iceland, Indonesia, Ireland, Italy, Israel, Japan, Korea, Lithuania, Luxembourg, Malaysia, Netherlands, Poland, Portugal, Singapore, Slovakia, Spain, South Africa, Sweden, Switzerland, Taiwan, Thailand, Turkey, UK and the USA. The package has been used to model the evacuation capabilities of a wide range of proposed or existing buildings and crowd situations, from the Love Parade disaster analysis to the Beijing Olympics, from the 911 WTC investigation to the Statue of Liberty redevelopment. The software is used in design analysis for underground stations, high-rise buildings, hospitals, shopping complexes, school buildings, museums, theatres, airport terminals, sports stadia, external crowd events – virtually any type of situation involving the gathering or movement of people.

"buildingEXODUS Version 5.0 provides building engineers with a sophisticated and powerful analysis tool to simulate and analyse crowd movement and evacuation," says Professor Ed Galea, Director of the University's Fire Safety Engineering Group and developer of buildingEXODUS. "The new capabilities - a direct response to needs identified by our clients around the world - represent a quantum leap in the sophistication offered by buildingEXODUS, and will help to maintain the software as one of the most advanced crowd simulation packages available."

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buildingEXODUS

FACT SHEET:

Summary of new capabilities - Version 5.0

Functionality

- Escalators/Travelators
  - *New device types using the new transit node functionality that can be specified within a buildingEXODUS simulation.*
  - *Example Application: Representation of escalator in a rail station or shopping centre*
- Metered Gate
  - *New device that uses the new transit node functionality, allowing turnstiles to be modelled more accurately.*
  - *Example Application: Representation of turnstile in a rail station or library.*
- Transit Nodes
  - *This new node type enables stair / escalator / travelator / corridor / metered gate components to be represented as single nodes. This allows the user to manage the use and representation of the components locally, and also manage the manner in which these components are selected by arriving agents.*
  - *Example Application: Representation of movement between floors of a shopping mall, where shoppers can choose between escalators and stairs. Also the representation of people negotiating ticket gates within a train station concourse.*
- Occupant Queues
  - *Enables the specification of service time delays associated with specific queues. Also allows the shape of the queue to be specified and allows other agents to pass through queues.*
  - *Example Application: Shoppers moving between checkout lines, collecting tickets at an airport, etc.*
- Enhanced Itineraries
  - *A number of new tasks have been introduced to expand the flexibility of the itinerary system, including: group formation/disbanding, waiting, enhanced delay, agent removal, signage interaction, etc. This enables the user to develop more complex emergency and circulation procedures.*
  - *Example Application: Circulatory movement around an exhibition; emergency phased procedure including warden activities.*
- Social Movement
  - *Group communication and interaction has been expanded to allow itineraries to be exchanged in the communication process, along with*

the ability for group members to adapt their speeds to maintain proximity.
  - *Example Application: Families arriving at a sporting event as part of a larger crowd.*
- Enhanced Signage
  - *Agent's understanding of the routes available can now be influenced by the signs available within the geometry and the information provided by them. This can occur on a planned or emergent basis. Agent interaction with the signs is simulated to represent whether the agent sees the sign and then uses the information available. Recovery behaviours are also provided, should agents fail to find the desired sign.*
  - *Example Application: Interaction between visitors to an exhibition and the guidance provided by the organisers. Assessment of the coverage of a space given location of signs.*
- Response Time Distribution Curves
  - *Allows the specification of a user defined probability distribution for response times or other agent attributes.*
  - *Example Application: Inclusion of data-sets collected from trial evacuations within the assessment of structural changes to the building.*
- Obstacle Zones
  - *Enables the grouping together of sets of nodes into zones in order to dynamically alter the Obstacle values of their connecting arcs.*
  - *Example Application: Representation of the appearance of debris, part way through an evacuation, upon performance.*
- Randomise on Seats/Swap Locations on Seats
  - *Randomise on Seats/ Swap Locations on Seats randomises the starting locations of individuals initially on seat nodes, or swaps the location of those on seat nodes.*
  - *Example Application: Examining the evacuation of a theatre assuming that the audience is seated, but that the exact distribution of the audience is not known.*

Data and Statistics Collection

- Trace Control
  - *Allows the evolving experiences of one or more agents to be output throughout the simulation.*

User Interface

- Tabbed dialogue boxes
  - *Simplify presentation of certain dialogue boxes and simplify user access; e.g. Behavioural Options.*
- EXODUS Script File
  - *Enables the user to manage the use of buildingEXODUS via command line functionality.*
- Potential Assignment

  - *Allows exit attributes to be modified from a single dialogue box, enabling exit potentials to be more easily managed.*
- Expansion of Analysis Control functionality
  - *Now allows different conditions to be represented, including the interaction between agents and signage.*
- View Navigator
  - *Allows the user to easily move about within the currently selected geometry window.*
- Locate Person / Time
  - *Enables the members of the population who managed to evacuate before a given time to be identified.*
- Auto Find Compartments
  - *Enables Compartment Zones to be auto generated for data collection.*

Output

- Signage related
  - *Enables the user to assess the impact of the signage system. Provides information relating to sign usage including the number of people that used a particular sign, the signs that a person used, the evacuation performance of those who saw and those who used the signs, etc.*
- Itinerary Summary
  - *Enables the complete list of tasks performed by the population as part of their itineraries to be displayed within the Data Window Output tab.*
- Transit Nodes
  - *Allows the dimensions and performance of transit node devices used during the simulation to be output.*

buildingEXODUS output to vrEXODUS

- Transit nodes
  - *Enables the new transit nodes types of Escalators and Travelators to be depicted within the 3D virtual environment (i.e. vrEXODUS).*
- Ability to view the catchment area of signs
  - *Enables the signs and their corresponding Visibility Catchment Areas (VCA's) to be depicted within the 3D virtual environment (i.e. vrEXODUS)*
- Ability to define the floor heights
  - *Enables the height of each floor as defined within buildingEXODUS to be accurately depicted within the 3D virtual environment (i.e. vrEXODUS)*

buildingEXODUS software architecture

- **64 Bit Implementation:**
  - *Both 32 and 64 bit implementations are available enabling very large simulations to be run using the 64 bit implementation.*