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NEW RELEASE OF SMARTFIRE SOFTWARE ASSISTS FIRE ENGINEERS SMOKE OUT THE SECRETS OF FIRE

Fire and computer scientists at the University of Greenwich today announced the release of the latest version of their popular fire simulation software SMARTFIRE. Known as SMARTFIRE V4.0, the new release posses a host of new features designed to make the difficult task of fire simulation more straightforward and efficient, freeing the fire engineer to concentrate effort on design issues rather than routine computational issues. To achieve this, SMARTFIRE V4.0 is more than simply a computational engine; it is a complete ***Fire Simulation Environment*** that provides ***coupling to CAD*** for ease of geometry specification, ***parallel computation*** to reduce excessive run times and ***interfaces with evacuation simulation*** for life safety analysis.

Fire Simulation Environment

Unlike other CFD software used to simulate fire, *SMARTFIRE* has been *specifically designed and developed* as a Fire Simulation Environment *to be used by Fire Engineers* and is based on more than 20 years of CFD fire modelling experience of the Fire Safety Engineering Group (FSEG) of the University of Greenwich. The SMARTFIRE environment consists of a tool set of five interacting components that enable the fire engineer to; define the geometry through CAD import, specify the required physics through an intuitive graphical user interface (GUI), automatically and intelligently mesh the geometry, perform the calculations within a unique interactive environment and finally, rapidly view the results using a Virtual Reality type graphical environment.

"This release of SMARTFIRE addresses a host of issues associated with the typical fire analysis project, including Ease of Model Development through links to CAD, intelligent automatic meshing, and intuitive graphical user interfaces; Speed and Cost of Computation through the use of low cost parallel computing; and Life Safety Analysis, through the coupling of fire with evacuation modelling," says Prof Ed Galea, Director of the Fire Safety Engineering group at the University of Greenwich. "The SMARTFIRE Environment is a one stop shop designed to make the job of the fire engineer as easy as possible, freeing them to concentrate on creative design issues rather than wasting valuable effort wrestling with software usage issues."

Of the many new features available within the SMARTFIRE environment, the CAD Interface, Parallel Computing capability and the EXODUS link stand out as being true time saving innovations.

CAD interface

The new Scenario Designer tool provides a semi-automated graphical environment for the import of CAD (DXF) drawings for the creation of *SMARTFIRE* modelling scenarios from building floor plans. The tool understands layers used in DXF design drawings and can 'scan' for rooms within each floor plan. There are intuitive mechanisms for selecting portions of a complex building plan and selectively incorporating rooms, doors, windows, fires and vents into the scenario to be modelled.

"Manually constructing complex building geometries is an extremely labour intensive, boring and error prone process. Utilising the SMARTFIRE ability to read CAD drawings can significantly reduce the time and errors produced in manually generating the geometry," says Prof Ed Galea. "This feature coupled to the SMARTFIRE intelligent automatic meshing capability means that the fire engineer can do in hours what it previously took days to do and ensure that an accurate representation of the geometry along with a sound mesh is used for fire simulation"

Faster Computation

A major drawback of CFD fire simulation is the tremendous amount of time required to perform accurate simulations. The time required is dependent on the size of the geometry being modelled and the level of accuracy required. The spatial accuracy is dependent on the number of computational cells needed to define the 3D space being modelled. Typically hundreds of thousands or even millions of cells are required to produce accurate solutions. Even using modern high powered desk top PCs, this can take days of number crunching. The new SMARTFIRE release tackles this problem through the use of parallel computation. Parallel computation makes use of a number of computers working together to solve a single problem. With many computers working together, the problem can be solved faster than if a single computer was used. However, unlike many parallel applications that require specialist computer equipment and software, the parallel implementation of *SMARTFIRE* makes use of standard office PC's and ordinary Local Area Networks (LAN).

"The number one complaint from fire engineers concerning fire modelling is the time required to perform CFD fire simulations," says Prof Ed Galea. "The cost of doing anything about it is

their number two complaint. We have addressed both of these problems through the development of a parallel version of SMARTFIRE that makes use of standard office PCs and LANS that are typically found in most engineering offices. For example, using a network of 8 Intel P4 3.2 GHz PCs connected with a 1Gb/s Ethernet LAN, a 1 million cell problem can be solved in less than 1 day rather than the 7 days previously required. This development means that the fire engineer can improve their productivity many times over, at no significant additional cost."

Link to Evacuation simulation

Most fire simulations are undertaken as part of a life safety analysis. However, until the release of SMARTFIRE V4.0 there was no way to directly couple the results from a CFD fire simulation to a detailed evacuation analysis. A semi-automatic link has now been developed which couples the ***SMARTFIRE*** fire simulation software to the ***EXODUS*** evacuation modelling software (another FSEG product). This powerful combination brings a new dimension to life safety analysis.

"The linking of SMARTFIRE with EXODUS brings the accuracy of fire field modelling analysis together for the first time with the sophistication of human behaviour modelling. This powerful combination of two leading computational fire engineering tools enables the fire engineer to more accurately determine the performance of a building design by allowing them to directly gauge the impact of the evolving fire environment on the behaviour of the simulated agents within the evacuation model," says Prof Ed Galea.

SMARTFIRE is based on over 11 years of development by FSEG of the University of Greenwich, and more than 20 years of CFD fire modelling experience of FSEG team.

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Technical and Marketing Information (1)
THE SMARTFIRE SOFTWARE

The SMARTFIRE Fire Simulation Environment consists of the following key components:

- **Scenario Designer:**

The *SMARTFIRE* Scenario Designer allows the user to select whole, or portions-of, 2D CAD floor plans and to generate single- or multi-storey *SMARTFIRE* models from them. A supporting tool assists the user to identify "rooms" and there are object tools to add objects to the scenario such as rooms, ceiling apertures, doors, windows, obstacles, partitions, stairs, fans or fires.

- **Case Specification Environment:**

The *SMARTFIRE* Case Specification Environment is a highly intuitive tool capable of creating complex modelling scenarios by adding a variety of objects to a computational 3D "region". Obstacles and Thin plates can be used to sub-divide the region into rooms and coridoors. Portals and apertures are used to link the rooms. Vents provide door and window openings to the outside, and Inlets, Fans and Outlets can be used to create flow conditions generated within a mechanically or naturally ventillated building. Monitoring objects allow selective data capture during the CFD numerical processing and Triggering objects allow for transitional effects due to changes in geometry resulting from breaking windows. Whole building models (generated in the *SMARTFIRE* Scenario Designer) can also be imported.

- **Expert Automatic Meshing Tool:**

The *SMARTFIRE* Automated Meshing tool uses a rule based system to configure the distribution and number of cells used in the simulation. Once the automated mesh has been created the user can fine tune the mesh by adding / subtracting cells from any slice and / or altering the mesh distribution. Once the user accepts the mesh it will be realised as a *SMARTFIRE* modelling case and can then be processed in the *SMARTFIRE* CFD Engine.

- **CFD Engine:**

The *SMARTFIRE* CFD Engine is a fully unstructured 3D mesh code using Finite Volume methods. Simulation involves the solution of the Navier Stokes equations for compressible flow, Heat transfer including the two equation k-e turbulence model. Both the SIMPLE and SIMPLEC solution procedures are available. There are a number of iterative solvers including Jacobi, Gauss SOR and BiCG. Combustion is modelled using the Simple Chemical Reaction Scheme (SCRS) using either diffusion- or eddy dissipation- controlled reaction. Thermal radiation can be modelled using Radiosity-, Six-Flux- or a Multi-Ray- radiation model. Volumetric and Face Porosities are supported to provide flow restrictions where the restricting objects can not be meshed due to their small scale (compared to the scale of the rest of the scenario). An integral restart database management system is included in the User Interface. The database uses file compression to minimise the storage requirements and keeps the restart data sets separate from the case and results files. The CFD engine can also be configured to run in parallel over multiple PC workstations.

- **Data Viewer:**

SMARTFIRE DataView is a post processing visualisation/animation tool. DataView provides easy access to visualisation functionality such as iso-surfaces, contour fill cut planes, velocity vectors and volumetric smoke visualization. The Data Viewer enables the generation of VR style graphics and animations for effective interfacing with clients. S*MARTFIRE* can also be configured to output data in a number of different formats for use with third-party post processing visualisation tools such as Tecplot, MayaVi and Ensight 6/Gold.

Technical and Marketing Information (2)
The Fire Safety Engineering Group

The Fire Safety Engineering Group (FSEG) of the University of Greenwich was founded by Prof Ed Galea in 1986. Today, with approximately 30 fire engineers, mathematicians, behavioural psychologists, software engineers and researchers, FSEG is one of the World's leading centres of excellence dedicated to the pursuit of Computational Fire Engineering (CFE). The work of FSEG includes research/consultancy, software development, international standards development and education.

FSEG research and consultancy is focussed on the development and application of CFE tools used to predict how fire and people, subjected to fire, behave. FSEG expertise is applied not only to the building sector but more widely to the aviation, marine and rail industries, essentially anywhere people come into contact with an environment fashioned by man. The group has published over 150 academic and professional publications concerning fire and related topics. Since 1991, FSEG has generated over £6 million worth of research and consultancy funding and its research and knowledge transfer activities have been supported by organisations such as: Arup Transportation, EADS, BAe Systems, Buro Happold, BMT, Canary Wharf Management Ltd., Office of the Deputy Prime Minister, MCA, NHS, Thales, UK MOD, Lloyds Register, UK CAA, Borealis, UK EPSRC and EU.

In recognition of their research, FSEG have been awarded several national and international honours including; 2004 European IST prize by the European Council of Applied Sciences, Technology and Engineering (Euro-CASE) for their development of the EXODUS suite of software, the Queen's Anniversary Prize 2002, RINA/LR Safer Ship award for 2001, the British Computer Society IT award for 2001, the British Computer Society Gold Medal for IT in 2001 and the 2001 CITIS Award for Innovation in IT for Ship Operation.

Research undertaken by FSEG has lead to the development of the CFE tools buildingEXODUS, airEXODUS, maritimeEXODUS and SMARTFIRE. These products are distributed world-wide by FSEG.

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