

Enhance Simulation Software Accessibility through Remodeling User Interface Focusing on Higher Education Students

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Abstract

Technology has been increasingly implemented as an effective tool to help improve student's ability to comprehend their environment, develop design solutions and estimate the appropriateness of their proposed designs. Through simulations, the students can visualize the performance of their design and anticipate unexpected complications. Technologies have also been proven as a useful tool to help higher education student's grasp disaster situations outbreak and their consequences. Among the field of disaster mitigation and prevention, the Fire Dynamics Simulator (FDS) has been described as an adequate tool to simulate flame spread rate during fire outbreaks, as well as smoke flow. However, this tool is not considered accessible to students because of its elaborated features that can be challenging to understand and time-consuming to render. The EDISON Platform, a hub that provides accessible simulation solutions for students free of charge, was used as the host to create the Graphical User Interface (GUI) FDS Module. The proposal implemented a GUI for the FDS tool, facilitating the simulation process while addressing three main challenges for students to access the existing version of FDS. The current FDS version requires programming logic understanding from the users. For example, the construction of the FDS files is based on Namelists and Command Line Interface (CLI) is used to render the model. Furthermore, three different environments are needed to complete each simulation. In the suggested GUI FDS Module, all the procedures required for simulation completion can be done within one environment and no programming knowledge is necessary. Secondly, since the GUI FDS Module runs the simulation on the Korea Institute of Science and Technology Information (KISTI) supercomputer, the simulation is expected to be done faster than if rendered using the student's personal computer. Finally, even though the current version of FDS is downloadable without any charge, it is common that users find the FDS excessively complicated and select one of the available commercial GUI versions of FDS when doing fire assessment and research. The proposed GUI FDS Module will provide an FDS GUI option free of charge and open to the community, focused on higher degree students.

Keywords: Simulation, Fire Education, Interface

1 Introduction

Science and technology have been used as resources to describe, analyze and predict sophisticated systems [1]. Within the technology field, simulation models are being improved continuously aiming to enhance the human ability to generate hypotheses and theories based on a real-world phenomenon. Simulations can be described as any means used to translate elements within different realities with accuracy. Model simulations have also been introduced as a mechanism to enhance higher education and are considered an effective tool to learn [1]. Thus, they can also be implemented within a wide range of set-ups within diverse education contexts [2]. Therefore, simulations have proliferated in higher education contexts and, through simulation, students can make informed decisions and appraise the results within a low-risk, efficient environment [3].

Technology has been increasingly used as resources to verify disaster-related approach and help students understand and visualize hypothetical disaster scenarios. As a result, simulations are effective means to help students understand, predict and mitigate disaster scenarios [1, 4, 5]. Especially focusing on fire safety and prevention, better designing tools, including simulation, can help achieve a more iterative designing process [6]. However, as a result of limited resources, lack of knowledge or time, technology is often not accessible to non-specialists, including students [7, 8, 9].

Therefore, to mitigate such limitations, we propose a conceptual model of a platform capable of enhancing the student's usage of Fluid Dynamics Simulator (FDS) to simulate fire occurrence. Several improvements to the available FDS were already suggested [10]. However, the designed methods were complicated, and the suggested solutions are not easily

available to regular users. The EDISON Platform, supported by KISTI, is a website to provide accessible simulation solutions free of charge. The research presents an GUI FDS Module that will offer an improvement on the user interface during information input, rendering process and result visualization. The suggested approach will be introduced to common users, especially focused on university students through the EDISON Platform. We believe that the proposed module will simplify the complex process of simulating fire outbreaks. The user-friendly interface, expected reduced rendering time and open source characteristics could lead to increase in student engagement in fire resistance determination and could result in more robust designs regarding fire safety. After introducing the conceptual model for the platform under development, we explain how the result should look like.

2 Literature Review

2.1 Simulation usage in Higher Education

Simulations have been used as tools in traditional education contexts [5]. Hopwood, Rooney, Boud, & Kelly (2016) argue that the usage of simulations among higher education curricula has increased over the years due to diverse reasons. In addition to being able to combine a wide range of curricular content, simulations also provide a safe environment where errors can be made without causing harm to others. Rutten, van Joolingen, & van der Veen (2012) compliments that, thought simulations, students can engage in an authentic and self-driven gain of expertise. For that reason, it is argued that simulation models can be used as educational tools to enhance the learner's experience [11]. Rutten et al. (2012) offer a summary of papers discussing simulation tools used for educational purposes and concludes that simulations are robust tools that have become additional resources for teaching methodology. Likewise, Rutten et al. (2012) argue that there are several advantages in simulation usage on higher education contexts, among them, interactivity and feedback, playfulness, problem-based learning realism and immersion can be cited as simulation benefits. Results indicate that simulations are useful in maintaining student motivation and supporting the student on learning achievement.

Among the educational fields, there has been an increasing interest in disaster-related instructional methods. From the pedagogic perspective, disaster simulations are beneficial because they demonstrate means for direct experience presentation without requiring the setup of real scenarios [09]. Also, Hong & Lee (2018) argues that simulations enable successive testing of a given system behavior given hypothetical scenarios, which can be considered a beneficial tool to evaluate design problems and solutions [12].

Cheng et al. (2018) state that it is necessary to plan escape routes in case of accidents at offshore oil and gas platforms (OOGPs). The authors suggest that simulations produced by computational tools could be used for that purpose. There is a

simulation model for OOGPs created by Cheng (2018). The model has been designed integrating Building Information Modeling (BIM) software and Agent-Based Model (ABM) [13]. The suggested model includes four components: evacuation model input, simulation environment modeling, agent definition and simulation and comparison. The paper conducted simulations with four different scenarios and proposed results that show not only agents ways to evacuate but total escape time through illustrations as well as graphs. It proved that simulation shows precise evacuation plan. The verification will be further developed to include fire simulation, as well, using the FDS tool.

Shen, Huang, & Chien (2008) argue that using fire assessment simulation tools provides information about the fire scene and fire development process. The simulation results can enhance the information about fire and smoke developments and guide the course of future fire accident investigations. Furthermore, the simulation data can collaborate to narrowing the possible causes of fire outbreaks [14]. The paper is based on the evaluation of an arson fire outbreak in Taiwan. The building was modeled according to the architectural designs and the fire estimation was done according to the surviving victims' statement. The simulation results produced by the academia were then applied to support the fire scene investigation. Therefore, simulation tools can be used to better understand the causes of accidents and disasters in addition to aid the development of policies for the protection of life and property. Finally, Shen et al. (2008) argue that fire simulations could also be helpful regarding the legislation and fire code development.

Radianti, Lazreg, & Granmo (2015) propose a serious game design applied to the Information Systems for Crisis Response and Management summer course students to introduce them to information management scenarios during an unpredicted crisis. The goal of the course was appraising the usage of a mobile application with realistic fire simulations aiming to guide victims of a burning facility to a safe area [15]. After the game, questionnaire and interviews were done to assess the effectiveness of the app and the general user experience. Through the experience, the students were able to evaluate the benefits and limitations of the app as a management tool. Even though the participants considered the app effective as a decision-making tool, there were critical limitations regarding information visualization and overflow of cognitive tasks caused by excessive information provided by reality and simulation at the same time.

Hong, & Lee (2018) presents a study to verify the fire egress planning done by architecture students using a human behavior simulation tool. The study proposes the combination of Building Information Technology (BIM) with human behavior simulation resource [09]. To proceed with the verification, a comparative study was done with 70 architecture students from South Korea. The students were expected to verify their design proposals concerning fire resistance performance using evacuee escape pattern simulation of. After evaluating the solutions offered and the student's self-appraisal about the performance

of their design, the authors conclude that using the simulation helped the students find unforeseen problems, evaluate their design performance, proceed the experimentation procedure more efficiently and chose the best options with relative lack of difficulty.

2.2 Fluid Dynamics Simulation (FDS) advantages and challenges

Historically, building safety study and standards were based on historical fire incident investigations leading to rigid requirements. Nevertheless, as the field of fire safety has expanded, performance-based evaluation options have been slowly introduced as one of the useful resources to evaluate and increase facilities fire safety performance [6]. Thus, the usage of computer models in the fire safety engineering field has been growing steadily during the last decades. Following this growth, more advanced simulations made it possible to do detailed analysis [16]. According to Johansson, & Ekholm (2018), Radianti et al. (2015) and Xu, Zhang, Lu, Zeng, & Guan (2018), among the several available modeling tools, the Fire Dynamics Simulator launched by the National Institute of Standards and Technology (NIST) in the United States is the most recognized tool for fire simulation among engineers and researchers.

One of the studies that applied the FDS simulation tool as a resource to determine fire breakout is Xu et al. (2018). In this research, a post-earthquake fire simulation capable of considering the seismic damage of sprinkler system into account to get more accurate results is proposed. Xu described that fire is a common result of earthquake occurrence, but there are no simulation resources capable of efficiently integrating a wide range of variables, such as post-earthquake sprinkler damage and fire outbreak, to obtain a detailed result [10]. For that reason, Xu et al. (2018) propose integrating the information supplied by several sources in a complementary way since a currently available software does not offer this combination. Through BIM it would be possible to acquire further details for earthquake potential damage on the sprinkler system and translate it, using the designed methods, into the fire assessment, keeping the damaged sprinklers from setting off during fire simulation. One of the common challenges to simulation accessibility is the fact that the tools used in research regarding fire safety are often commercial software versions. For example, the tools used in this study case, Revit for modeling and sprinkler positioning and PyroSim for fire simulation are both owned by private corporations. The described limitation can lead to a difficulty in making the fire simulation appraisal a widely applied methodology during the design process for both students and professionals.

Moeseneder et al. (2015) focus on improving the interface of an existing simulation tool designed to verify water quality. According to the author, the simulations tools used for management decisions commonly lack interactivity regarding the range of possible decisions and visualization of results.

Therefore, it is essential to develop a less complicated software based on parametrization and improve user interaction focused on supporting user learning [7]. The proposed system aims to implement an interactive system that stimulates economic and social impacts of water-quality alteration. Moeseneder et al. (2015) argue that following the increase in choice complexity and simulation feedback, the user learnability decreases, for that reason the simulation software provides results that are simplified. Finally, the author concludes that the simulations software should focus on facilitating the development of solutions that can be rendered efficiently, promoting learning [7].

According to Johansson, & Ekholm (2018), since it is difficult to determine the fire spread pattern using FDS, the user must specify the heat release rate instead. Such usage of fire simulation software usually expects the user to have extensive knowledge about fire dynamics. Furthermore, the software can withhold information used during calculation process, causing the user to have difficulties in analyzing the simulation results [16]. Radianti et al. (2015) describe FDS as an efficient resource in case of simulating low-complexity models. However, he states that as the geometry increases in sophistication, the modeling can become time-consuming. Also, the chance of unexpected errors occurrence is higher [15]. Thus, the computational process also gets more expensive. Even experienced researchers claim to have difficulties comprehending FDS errors, regarding parallel processing and matching meshes during FDS usage [14].

Following the reasons described above, it is possible to verify that inexperienced students have trouble using simulations to do design assessment because it is expensive [9], it requires specific programming knowledge [16], as well as, being a time-consuming task [7, 14, 16]. In addition, due to the interface limitations and high intricacy process necessary to do the results evaluation, among other causes described before, several simulation tools, FDS included, can't motivate and keep students engaged in the long term [8, 9].

The tools' high level of difficulty also has a negative impact on the construction field. New concepts and tools need to be created and presented in order to change the building industry perspectives and misconceptions about fire safety design [6]. It is important to reflect carefully about the civil engineering field aspiring to launch proposals that could impact real projects in addition to proposing solutions that foster fire safety performance within the design process itself. Furthermore, Maluka, Woodrowc, & Toreroa (2017) describes that currently there is a suboptimal exchange between building design and fire safety measures. The system behavior regarding fire events need to be understood, and he suggests that fire safety could be considered a design variable instead of a design constraint [4]. Aiming to achieve this integration, computational tools are introduced as an increasingly popular resource to achieve proper analysis thresholds [4].

2.3 Summary

After reviewing the work related to simulations tools used in higher education in addition to the state of art emergency simulation response and prevention tools and research, especially those regarding fire safety design, it is believed that the fire safety design resources provided to the public, especially higher education students, could be enhanced by conducting the following activities:

- Promote the usage of the FDS tool within non-specialists by improving the usability and simplifying input method that is described as complicated
- Make the FDS more accessible by reducing the rendering time requirements through request process of rendering (using an institution's supercomputer, instead of a personal device to render)
- Promote a more iterative process of building design by facilitating the fire safety evaluation of design solutions through the production of an improved platform that won't burden the student's design process and cause workload to increase due to fire assessment

3 Conceptual Model Proposition

3.1 Existing and proposed set up process

Gu, & Blackmore (2015) describes that usability limitations and restrictions impact the user learning experience [17]. In accordance with Cope, Richmond, James, Gurney, & Allerton (2017) who argues that several existing modeling and simulation creation tools rely on prior programming knowledge which limits the accessibility to students who lack the expected level of experience in programming [18]. Cope et al. (2017) follow to argue that Graphical User Interface (GUI) features allows the user to apply previous existing knowledge such as drag and drop and property editing to a wide variety of modeling tools. Therefore, this research paper aims to present an improved GUI solution for FDS tool with open access and free of charge.

In order to enhance the FDS user interface, first it was necessary to understand the existing FDS file construction and rendering processes to identify how the modeling method could be improved through a GUI proposal. Following the Fire Dynamics Simulator User's Guide and using the 6.6 FDS version, a case study was completed to reveal the barriers that inexperienced users could potentially encounter. Furthermore, it was an insightful opportunity to identify which inputs could be simplified through an improved GUI as well as how the simulation process altogether could be facilitated.

The FDS tool can be described as three main procedures [19], as seen in Figure 1. First, the user produces a FDS file according

to their purpose using the Namelist statements present in the Fortran programming language methodology. Thereafter, the command prompt window is used to call the FDS file and render the simulation. Once the simulation is completed, another program, called Smokeview, should be used to display the results in a graphical interactive manner. On the other hand, as seen in Figures 1 and 2, the suggested GUI FDS Module supports all the operations required starting at the input information until the download of the simulation result file. The user can navigate the platform sections to insert the required data and connect each inputted information. The proposed solution also supports inputs from previously existing FDS files. Existing files can be imported into the proposed platform and further modifications can be done using the GUI FDS Module. Finally, the results are supplied through a downloadable video file.

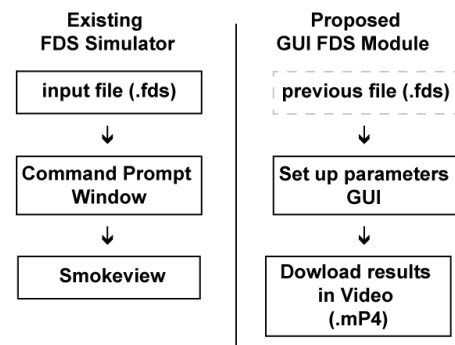


Figure 1 Proposed GUI FDS Module and Traditional FDS Structure Comparison

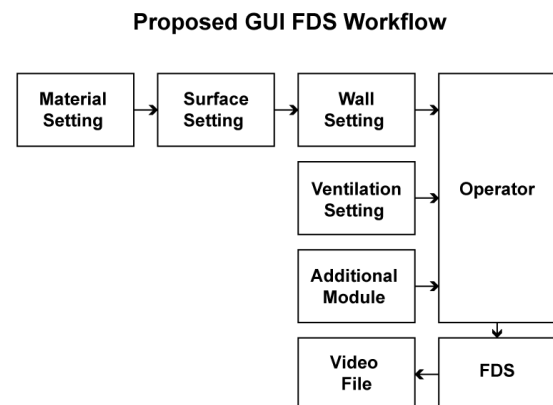


Figure 2 Proposed GUI FDS Module Conceptual Structure

The Fire Dynamics Simulator User's Guide will be used to walk the reader through the available FDS file construction process and each step improvement in the suggested GUI FDS Module. Regarding the FDS input file structure, the User's Guide first explains how to use the appropriate format to

include inputs [19]. Each type of input has different requirements, as seen in Figure 4, which can confuse an inexperienced user. Regarding the GUI FDS Module, part of the technical information will be calculated by the system itself. Therefore, all non-critical inputs expected from the user were removed. This solution unburdens the inexperienced user with technical details and facilitates the simulation set up process.

The existing FDS version expects, in addition to the file name, also the simulation time, mesh size and heat sources setups, as seen in Figure 4 [19]. According to Radianti et al. (2015) and Shen et al. (2008), the mesh setting can become excessively complicated and time-consuming, since a wrong configuration on this component can compromise the entire simulation and unexpected errors can occur. The GUI FDS Module will resolve this obstacle by calculating automatically the best fitting mesh size for the given model. This solution will reduce the amount of background information required from the user to run the simulation successfully.

After that, the FDS Guide proceeds to the explanation of the materials and surfaces configuration [19]. Materials can be described as representations of existing building physical resources. While surfaces are the mechanism to describe the external conditions of any given obstructions. Every surface should contain at least one material and its respective width, but it can also contain more than one material to simulate layers of materials on top of each other [19]. If the user wants to describe a complex surface, several layers of material must be included, which can lead to errors and internal conflicts. The solution facilitates this process by providing easy material assignments within the surface section, as well as include the data through input boxes aiming to facilitate the surface creation and avoid user annoyance, as seen in Figure 3 and 5. This method also reduces the chances of mistaken setups that could lead to unexpected rendering errors.

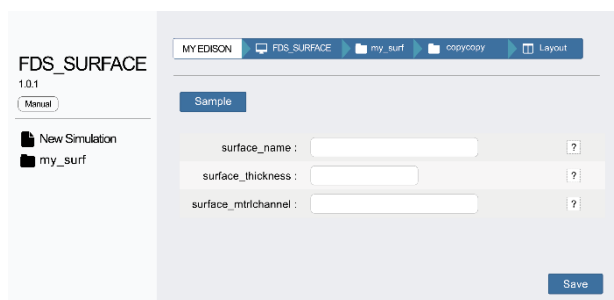


Figure 3 Screenshot of the Proposed GUI FDS Module

Furthermore, the geometry modeling in the FDS 6.6 version defines that each entity should be described by two points (x1, y1, z1 and x2, y2, z2) to determine its length, width and height [19]. In addition, it is possible to assign the previously cited surfaces to each object, as seen in Figure 4. Because the simulation rendering times are usually long and require an

extensive computing power, it is common that elaborated models present errors at this stage due to lack of previous rendering visualization. The research papers that implement FDS as their resources of analysis usually adopt supporting modeling tools to create the shapes. After the models are finished, a FDS file format is exported to facilitate the obstructions description [10, 15, 09, 20].

In the planned Module, the possibility to import a previously existing FDS file was intended to make it possible for users to directly include their existing obstructions file in the GUI FDS Module, as seen in Figure 1 and 5. If an obstruction file is not available, the user can create the obstructions by inserting the requested information in the appropriate input boxes and assigning surfaces by drop-down menus through the platform GUI.

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1 &HEAD CHID='OpenPILOTISFinal_Jaewan', TITLE='FinalCaseStudy'/
2 &TIME T_END=3000.0/
3 &DUMP RENDER_FILE='OpenPILOTISFinal_Jaewan.ge1', COLUMN_DUMP_LIMIT=.TRUE., D
4
5 &MESH ID='mesh', IJK=100,100,50, XB=-25.867,24.133,-26.566,23.434,-0.077,7.2
6
7 &MESH ID='Emesh01', IJK=200,200,1, XB=-25.867,24.133,-26.566,23.434,4.18882
8 EVACUATION=.TRUE., EVAC_HUMANS=.TRUE., ID='MainEvacGrid'/
9
10 &MISC EVACUATION_MC_MODE=.FALSE., EVACUATION_DRILL=.FALSE., /
11
12 &SPEC ID='WATER VAPOR'/
13
14 &REAC ID='polyurethane',
15 FUEL='REAC_FUEL',
16 C=1.0,
17 H=1.75,
18 O=0.25,
19 N=0.065,
20 CO_YIELD=0.02775,
21 SOOT_YIELD=0.01575,
22 HEAT_OF_COMBUSTION=2.53E4/
23
24 &MATL ID='MT_CONCRETE',
25 SPECIFIC_HEAT=0.88,
26 CONDUCTIVITY=1.0,
27 DENSITY=2100.0/
28 &MATL ID='GYPSUM PLASTER',
29 FYI='Quintiere, Fire Behavior',
30 SPECIFIC_HEAT=0.84,
31 CONDUCTIVITY=0.48,
32 DENSITY=1440.0/
33 &MATL ID='PAINT',

```

Figure 4 Existing FDS File Structure

According to the User's Guide, the user must use the HOLE Namelist to create holes in the obstructions, for windows or doors, for example. The holes are defined similarly to the obstructions [19]. In the proposed GUI FDS Module, hole definition is related to the obstruction creation method. The hole and obstruction set up method is similar as well, by inserting the designated information through input boxes.

The Guide continues to describe several additional features that can be included to approximate the simulation as much as possible to reality. Among them, there are ventilation planes and type of desired output, for example [19]. In the EDISON Platform, after the user concludes the data input through the methods described above, KISTI supercomputer will render the simulation and a video file will be produced. Finally, the result can be downloaded to the user's personal computer in MPEG-4 format. The Proposed GUI FDS Module is expected to be able to run the features available on the FDS 6.6 version when all modules are fully implemented.

3.2 Proposed GUI FDS Design Guidelines

3.2.1 Node-based Graphic User Interface Design

The modularity characteristic of the Proposed GUI FDS Module, as seen in Figure 2, makes it possible to incorporate additional methods to the existing ones as the research progresses. It also facilitates the implementation of EDISON suggested GUI FDS's visual programming feature, as seen in Figure 5. According to Plauska, Lukas, & Damasevicius (2014), visual elements are more natural solutions than text considering programming processes because they represent more accurately parallel behavior of complex systems, comprised of several components. The authors argue that visual solutions are important in education since they eliminate the need of prior programming knowledge and are visually engaging to the students [21].

The designed solution proposes that the connection between the described FDS components could also be done by visual programming techniques, aiming to reduce user resistance towards the tool and facilitate the visualization of the FDS file structure composition, as seen in Figure 5. If the connection between the several sub-modules necessary to construct the FDS file is done visually, it will help inexperienced users understand how each component relate to each other and it will also improve their broad understanding of the FDS tool.

Furthermore, when designing the FDS GUI solution, several design concepts were applied to achieve the most appropriate user interface. Among them, the general principles related to the design of Graphical and Web User Interfaces described by Galitz (2007) was used as a general reference for best design practices. Following this guideline and additional references, the design choices will be explained in the next section.

3.2.2 Aesthetics

Within the general principles, the contrast between visual elements and the grouping arrangements are fundamental for user interface design [22]. The color usage is one of the design decisions that can impact user's visual perception and facilitate the contrast and grouping perceptions. Regarding the proposed solution, aiming for a pleasant aesthetics, the main color scheme was chosen as pale and lighter tones for backgrounds and darker tones for titles, as seen in Figures 5 and 6. As claimed by Cyr et al. (2010), the contrast between blue and gray creates an aesthetically pleasing environment for users. In the suggested solution, grouping can also be easily perceived within the node design feature by color usage.

Seckler, Opwis, Tuch (2015) and Cyr et al. (2010) described the fundamental role color schemes have on the aesthetic design of digital interfaces. The Proposed GUI FDS Module has chosen blue, green, red colors, adapting the Split-complementary color scheme. The scheme describes three colors usage, which one color becomes base and the others function as complementary

colors. As seen on Figure 6, each sub-module connection status can also be assessed by color status. Green connections mean fully functioning connection status, while orange color indicates that the connection process failed and should be revised by users.

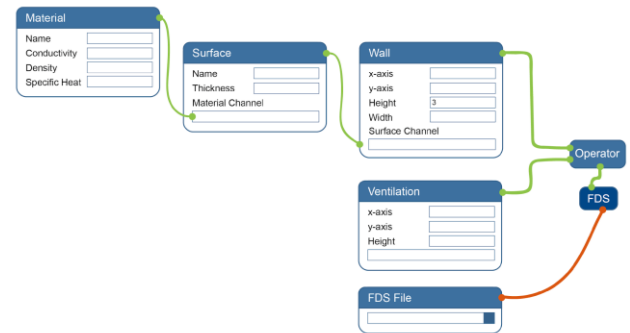


Figure 5 Proposed GUI FDS Visual Programming Using Sub-modules Structure

3.2.3 Clarity, Simplicity and Familiarity

Words and visual appearance should be cleared to facilitate understanding [22]. Therefore, the proposed GUI FDS Module maintained the naming and the logic used in the existing FDS solution, described earlier, to facilitate user task completion, taking advantage of the user's familiarity with the existing solution. Furthermore, the color uniformity helps reduce the complexity of the system.

3.2.4 Comprehensibility

The node-based design helped facilitate the structure comprehensibility. The users' flow of actions necessary to achieve the desired goal can be visually understood instead of relying on user's previous programming knowledge. The sub-modules necessary to complete a fire simulation can be seamlessly connected by user intervention through information input and sub-module manipulation, as seen in Figures 05 and 06.

3.2.5 Consistency

The proposed solution is also based on a consistent design solution to promote user understanding and reduce learning requirements for task completion [22]. Throughout the GUI FDS Module, the number of information required from the user was reduced, and the input methodology was standardized to aid novice users in understanding the process. As seen on Figure 6, inputs with fixed values show a dropdown list and the design helps users to grasp what type of input each section requires.

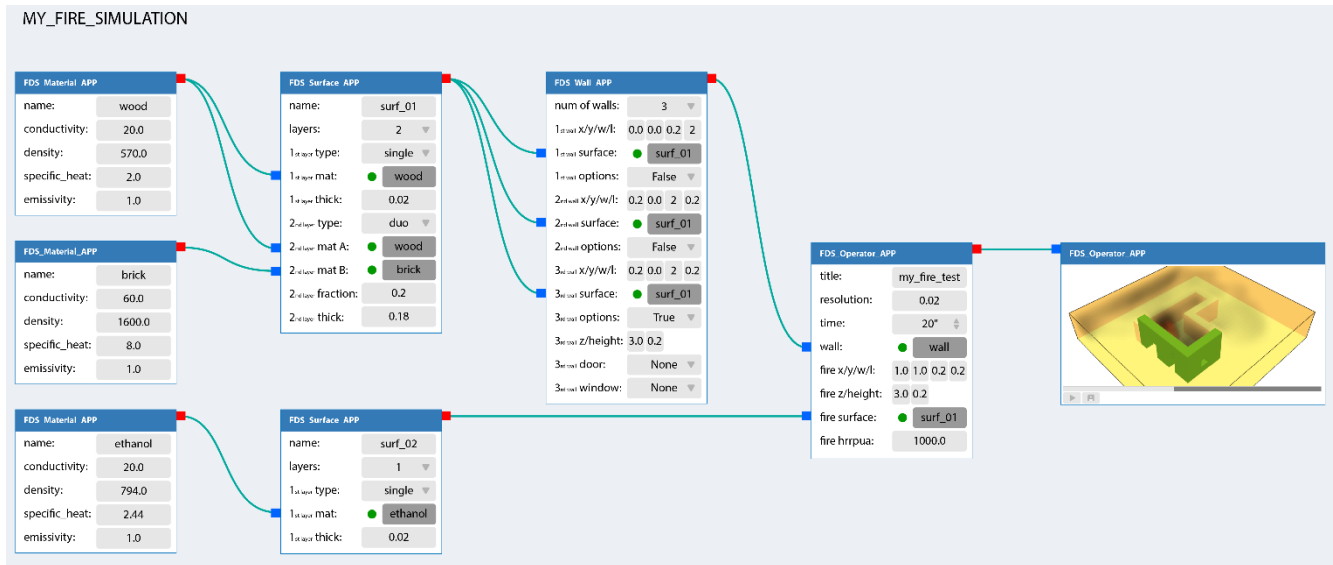


Figure 6 Proposed GUI FDS Module Detailed Node-based Structure

According to Bi et al. (2011) and Seckler, Opwis, Tuch (2015) symmetry is one of the features responsible for a pleasant aesthetic and consistency perception. Therefore, as seen in Figure 6, each sub-module is designed following the same scheme, description on the left and input space on the right. Similarly, connections between modules should always follow the same path. Sub-modules should be connected with previous entrances by the left-side and with posterior entrances by the right side, as seen on Figure 06.

3.2.6 Control

The node-based proposed solution also encourage the user to focus on the intended goal instead of focusing on technical details. Therefore, it is possible to present the same simulation result using an interface that is more compatible with user's skills and experiences. Besides, the proposed design permits the user to customize the simulation using a seamless method, increasing their sense of control over the process. The user perspective is the focus of the suggested solution, while the interface is used as a tool to achieve the desired goal. Furthermore, the illusion of object manipulation, by selection and connecting features of node-based design enhance the user sense of control [22].

4 Result

As discussed in the previous sections, through the suggested platform we expect that the FDS usability will be enhanced leading to increase in tool usage rate and user satisfaction. As mentioned by Roldán-Álvarez, Martín, García-Herranz, & Haya (2016), it is critical to reduce the effort necessary to start using the tool while diminishing the limitations for experienced users. The user-friendly EDISON GUI will support the inexperienced users and facilitate the simulation process, while

the modularity aspect will permit features expansion in the future to include more complex additional components of fire simulation.

Following the research goals, the Platform improves the usability and simplify input method, therefore facilitating FDS usage by students. In addition, EDISON Platform also facilitates student accessibility to FDS features because it provides simulations with shorter rendering times, using KIST supercomputer. As a result, the suggested solution helps include fire assessment as an iterative design process, aiding students to improve their design solutions.

According to the descriptions made so far, we introduce the foreseen results after the EDISON system is fully implemented. The case study demonstrates the EDISON potential to supply equivalent results to FDS, once all the described features are completed. Thought the case study, it was possible to appraise different hypothetical scenarios for the Jecheon Sports Center fire accident that occurred in December or 2017 in South Korea. The simulations were based on three different scenarios and their effect on flame spread rate and smoke dispersion under the fire outbreak situation. The first scenario was modeled as a reproduction of the fire accident without any modifications to establish a basis for comparison and the results for that scenario can be seen in Figure 7.

The second scenario aimed to analyze the fire development if the first floor of the building was not pilotis but traditional construction composition, with exterior walls around it. The hypothesis that the limitation of oxygen provision could possibly extinguish the fire was the theoretical basis for this scenario creation. The simulation results, as seen in Figure 8, showed that the fire spread rate increased, and smoke flow reached more critical thresholds.

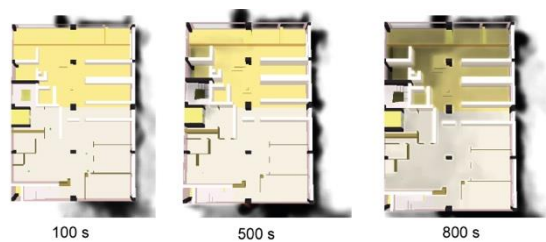


Figure 7 Smoke Simulation Result – First Scenario

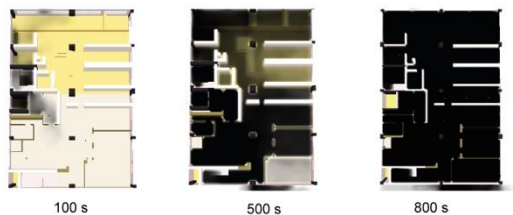


Figure 8 Smoke Simulation Result – Second Scenario

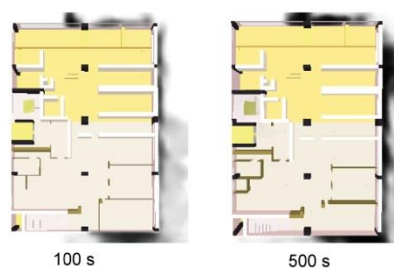


Figure 9 Smoke Simulation Result – Third Scenario

Finally, the sprinkler system located in the building didn't go off as expected because of technical difficulties. Therefore, the third scenario predicted the fire development if the sprinklers would have worked as expected. The main goal was access to which extent the sprinkler system could have had in the flame spread and smoke flow. As seen in Figure 09, there was a slight reduction in temperature increase, but no relevant difference could be found on smoke flow.

As described above, the case study was an important step in the EDISON proposal development and assessment since it provided information about the student's common difficulties and barriers when using the FDS simulation tool.

5 Conclusion

The research was developed aiming to enhance the accessibility of higher education students to cutting-edge simulation tools.

Through the literature review, it was possible to understand that simulations have become an effective tool to help students evaluate the performance of their planned solutions. In order to grasp the current state-of-art simulation tools focused on disaster scenarios, several study cases were analyzed and the FDS tool was selected as focus of this research. The production of a fire simulation study case was the start point to investigate the FDS potential and its interface limitations. Several constrain points were identified and resolved by the proposal of an open access FDS GUI Platform. It is possible to conclude that the EDISON Platform, once fully implemented, will facilitate fire simulations. Also, it is expected that the FDS accessibility will increase, since the need of prior programming knowledge and robust rendering computers was eliminated in the EDISON suggested model.

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