Comparative analysis of engineering tools for modeling and analysis

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Abstract. The paper presents a comparative analysis of engineering tools that are widely utilized in major industries. With the rapidly changing world, new tools emerge and advance, enabling their use for various tasks. Modeling and analysis of structures with complex and simple appearances are an essential part of the engineering world, and hence, choosing the right tool for a certain task can be beneficial in terms of quality and the precision of the end results. This reviews several engineering tools and defines their major advantages. Such tools as SolidWorks, Ansys, Abaqus, Inventor, and Fusion 360 were selected for the research. It is noted in the work that these tools are commonly used in the engineering world for various tasks. It was also found that each engineering tool has its own unique features that differentiate it from others.

1 Introduction

In the market there a lot of different tools for various tasks. By tools it is referred to software that are used for content creation, analysis, entertainment and so on. This work will go through software that are used for modelling and analysis. It is true that there is a lot variation of tools that most of the time perform similar tasks, but also, they can have a feature that make them to standout from others. Engineering tools penetrated all the major fields and sectors and their applications play important role in the whole system.

As it was mentioned above there are tools that can be used in various sectors. For instance, for entertainment and content creation 3ds max, Blender, Cinema4 can be used. For sure they can be used to model and do analysis, but most of the time they are made for the aesthetic reasons. It is also true that the end result is expected to be a model with focus being shine upon its appearance rather on its realistic world parameters. These software packages mostly focus in their functionality on modelling, texturizing, animation and rendering. On the side there are software which is devoted for engineering purposes. These tools are built to satisfy the engineer's needs. In their functionality they focus on precision to real-world parameters. Most of the popular tools in the market for the engineering purposes are: SolidWorks, Ansys, Abaqus, Inventor, Fusion360 and so on. These tools are capable of performing various tasks.

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Form complex analysis of structures to a texturizing the end product. Also, the focus of this work will be on the second mentioned tools [1, 2].

This work was done to analyse the available tools in the market and their capabilities in certain environments. There are numerous numbers of different engineering tools available in the market that can be used for various task but most of the time it is hard at first to understand their capabilities and functionality. Therefore, this work will look through several tools that can be used for engineering purposes.

2 Materials and methods

In the rapid changing world new ideas and technologies must be implemented. The fields that lack advancement and progressiveness must be transformed using novel approaches. Modern challenges also require appropriate solutions. Due to the accumulated knowledge and development of robust foundation of technological chain old engineering tools are reshaping themselves to challenge modern issues.

Current engineering tools can be used for various reasons. They can be applied for entertainment and for complex analyses. The most usefulness of these tool come from their ability to analyses the structures under real world conditions. This allows wide range of application and outcomes.

It is hard to imagine living in a world where there is now such a tool that can illustrate the products lifespan in matter of time. It is also hard to imagine that every analysis would be done manually and experimentally in the real world, without any help of technology. The importance of these engineering tools beyond any comprehension.

3 Results and discussion

3.1 Engineering tools

SolidWorks is one of the most popular tools that can be named as the tool that as standard among it circle. If compared to others this tool occurred relatively earlier than others and hence can be name the one that guided others on the similar paths. This tool is widely utilized CAD software that can be used for creating 3D models and assemblies. It is also known for its user-friendly interface that is almost all other software packages copy or at least bases their layout. SolidWorks can be used for other tasks as well such as motion analysis, structure simulation, aerodynamics and so on. This tool also has extensive library of standard parts that make it a great chose for mechanical and product design. Also, its integration with CAM (Computer-Aided Manufacturing) and PDM (Product Data Management) further enhances its appeal among the users [3,4].

The other tool that will be covered in this work is Ansys. This powerful engineering tool is renowned for its capability to handle complex Finite Element Analysis, fluid dynamics and multiphasic simulations. While SolidWorks focuses on building the structure this tool can evaluate the performance of structures under specified constrains. The following software can be used to work with thermal, structural, and electromagnetic loads. Due to its analytical capabilities and diverse fields' scope the tool is widely utilized in the aerospace, energy, and electronics. This tool is one of the preferred choices within the scientist and researcher community as it can solve the problems with real-world outcomes.

Abaqus is somehow similar to the previous tool in it narrowed focus. The tool is created for analysis purposes in mid rather than modelling or assembly of the structure. This tool is high-end simulation tool that is capable of performing Finite element analysis with the inclusion of nonlinear analysis. Abaqus is used for complex simulations including fracture

mechanics and advanced material modelling. Abaqus can also be used in dynamic analysis that most of the tools lack in their functionality. It is also preferred by automotive and biomedical fields due to its precision and versatility. The one future that also is essential for scientists is the capability to change the build in parameters with the use of various programming languages. This tool can be customized by python language for any specialized engineering needs [5].

Inventor can be separated from others in a separate group as it is capable of performing all variation of tasks. However, the overall appearance is mostly similar to other software. Most of the engineering tools are generally focused on certain aspects, but Inventor tries to gather the whole functionality in itself. It is well suited for modelling and assembly of the structure of any complexity. It includes both analysis and drawing section. Its strength lies in its ability to work with the lager construction. The other advantage of using this tool its compatibility with the other software packages of Autodesk [6].

Fusion 360 is also from the Autodesk family. This tool is similar to the previously mentioned engineering tool Inventor, but depicts itself in a different way. The major dissimilarity from others lies in cloud-based capabilities. Similar to inventor this tool also appears to have wide range of functionality. The other advantages of using this tool is modern advancements such as generative design, topology optimization, and machining capabilities.

Table 1 provides a comprehensive overview of five popular software solutions: SolidWorks, ANSYS, Abaqus, Inventor, and Fusion 360. These tools provide to various aspects of engineering design, simulation, and analysis, each with its own strengths and target industries.

Table. 1. Comparative analysis of engineering tools.

Feature	SolidWorks	ANSYS	Abaqus	Inventor	Fusion 360
Primary Use	3D CAD design and assembly modeling	Advanced simulation (FEA, CFD, etc.)	Nonlinear and complex simulations	Mechanical design and product development	Integrated CAD/CAM/CAE platform
Specialized Tools	Motion studies, stress analysis	Thermal, structural, and multiphysics	Nonlinear material modeling, crash tests	Sheet metal, piping, and large assemblies	Generative design, topology optimization
Industry Focus	Mechanical, automotive, aerospace	Aerospace, energy, electronics	Automotive, biomedical, materials	Manufacturing, consumer products	Startups, makers, small-medium industries
Simulation Capabilities	Basic (motion and stress analysis)	Advanced multiphysics simulations	High-end nonlinear FEA	Limited (integrated simulation tools)	Integrated, cloud-based simulation
Collaboration Features	File-based sharing, PDM integration	Limited, typically local workstation-based	Python scripting for customization	Team sharing within Autodesk ecosystem	Cloud-based collaboration and versioning
Learning Curve	Moderate, beginner-friendly interface	Steep, requires simulation expertise	Steep, targeted at advanced simulations	Moderate, intuitive for CAD users	Easy, designed for both novices and pros
Cloud Integration	Limited	No	No	No	Yes

Cost	High (license-based)	High (license-based)	High (license-based)	Moderate (subscription-based)	Affordable (subscription-based)
File Formats Supported	.SLDPRT, .STEP, .IGES, .DXF	.ANSYS, .STEP, .IGES, .OBJ	.CAE, .INP, .STEP, .IGES	.IPT, .STEP, .DWG	.F3D, .STEP, .IGES, .STL

Table 1 clearly shows that each tool has a primary focus, ranging from 3D CAD design (SolidWorks) to advanced simulations (ANSYS and Abaqus) and integrated platforms (Fusion 360). ANSYS and Abaqus offer the most advanced simulation features, while others provide more basic or integrated options. In the framework of the industry focus it should be noted that the tools target different sectors, from aerospace and automotive to manufacturing and startups. As for collaboration and cloud integration, Fusion 360 stands out with its cloud-based collaboration features, while others offer more traditional file-based sharing. Assessing accessibility it can be seen that learning curves and costs vary, with Fusion 360 being the most affordable and user-friendly option.

Thus, the choice of engineering tool depends on the specific needs of the project, industry requirements, and user expertise. While some tools excel in advanced simulations, others offer more accessible and integrated solutions for a broader range of users.

3.2 Future possibilities

Future of engineering tools is a promising and anticipated event. With the development of new approaches and technology these tools will be capable of analysis more complex tasks. And with the establishment of quantum computing and with the next generation of artificial intelligence engineering software' will beyond anyone's comprehension. The major issue right now is related to the computational power and to the lack to analyses large and complex structures with dozens of different variables and parameters. With the use of quantum computing technology this issue can be solved. It is believed that this technology will solve complex task in a short period of time compared to the methods that are available right now. The combination of artificial intelligence and quantum mechanics will bring new features and capabilities that are yet to be discovered. It is hard to imagine the future as novel approaches and technologies are occurring daily and hence prediction of a clear future in this field is unattainable. But some major issues will be solved upcoming decades [7].

4 Conclusion

To sum up, this work looked into the engineering tools and their capabilities for various tasks. Engineering tools are used daily and their presence eases all the processes that can be performed by them. It is also essential to understand their uniqueness as all of them have different functionality and capability. Hence, diving into their constituents will make the process working on a given task easier and more productive.

This work studied various tools such as SolidWorks, Ansys, Abaqus, Fusion360 and Inventor. The research shows that these tools are greatly used in various industries and some of which can be seen as standard. This work briefly outlined the advantages and disadvantages as well as difference between tools for engineering. Future prospects of these tools were also discussed.

This work was supported by the Ministry of Science and Higher Education of the Russian Federation (Grant No.075-15-2022-1121).

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