Use of available engineering tools for modelling in multiple industries

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Abstract. This paper explores the diverse applications of modern engineering tools across various industries, including agriculture, medicine, robotics, and education. The study examines popular software packages such as SolidWorks, Ansys, Abaqus, Fusion360, and Inventor, highlighting their specific capabilities and uses in different sectors. In agriculture, these tools are utilized for equipment design, structural analysis, and safety improvements in production systems. The medical field benefits from engineering software for instrument development, analysis of human body parts, and treatment planning. Robotics heavily relies on these tools for part design, assembly, mobility analysis, and simulation of various scenarios. The educational sector, while currently underutilizing these tools, shows potential for increased integration to foster innovation and practical skills among students. The paper also touches on the use of engineering tools in entertainment and hobbyist applications. Looking towards the future, the study predicts significant advancements in engineering tools, particularly with the integration of artificial intelligence. These developments are expected to enhance intuitive design, simplify analysis processes, and expand capabilities for handling complex structures. This comprehensive analysis demonstrates the widespread adoption and versatility of engineering tools across multiple industries, emphasizing their crucial role in technological advancement and innovation.

1 Introduction

The market is full of tools capable of handling the modeling and analysis of different structures. These tools or software packages can be classified into different groups. From a distant perspective, one can divide these tools into two groups: media-related and engineering-related. The obvious difference between these two groups lies in precision, features and tools, approaches, and algorithmic use. Hence, it is important to clarify these aspects of the software before its usage [1].

The market is full of countless tools for various purposes. Most of these tools have found their niche and are firmly integrated into different industries that depend on them in various ways. The use of these tools in different fields and industries is numerous. For instance,

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manufacturing industries greatly utilize engineering software packages for product modeling and analysis. These tools can predict, through simulation, product wear due to use, weak spots, possible deformations due to misuse, etc. Some tools are used to create advertisements, close prototypes, and demonstrate the product's application and interaction with its environment. The use of tools can vary as much as the fields and areas they serve [2].

This paper explores the use of engineering tools in various fields. Different tools have different applications, and selected areas of use are covered. The areas addressed include the agricultural sector, medicine, education, unconventional design, and robotics. These areas represent the main users of engineering tools. While other fields exist that are not covered in this paper, most exhibit similar behaviors when applying these tools.

The study examines the diverse applications of engineering software across multiple industries. Each sector utilizes these tools in unique ways, tailored to their specific needs and challenges. For instance, in agriculture, engineering tools are employed for equipment design and safety analysis of production systems. In medicine, these tools aid in instrument development and analysis of human body parts. The robotics sector heavily relies on engineering software for part design, assembly, and mobility analysis.

The educational sector, while currently showing lower usage compared to other industries, demonstrates potential for increased integration of these tools to foster innovation and practical skills among students. Additionally, the paper touches on the use of engineering tools in entertainment and hobbyist applications, highlighting the versatility of these software packages beyond traditional scientific and industrial uses.

2 Materials and methods

2.1 Engineering Tools

The most common engineering tools are as follows: SolidWorks, Ansys, Abaqus, Fusion360, and Inventor (Figure 1) [3].

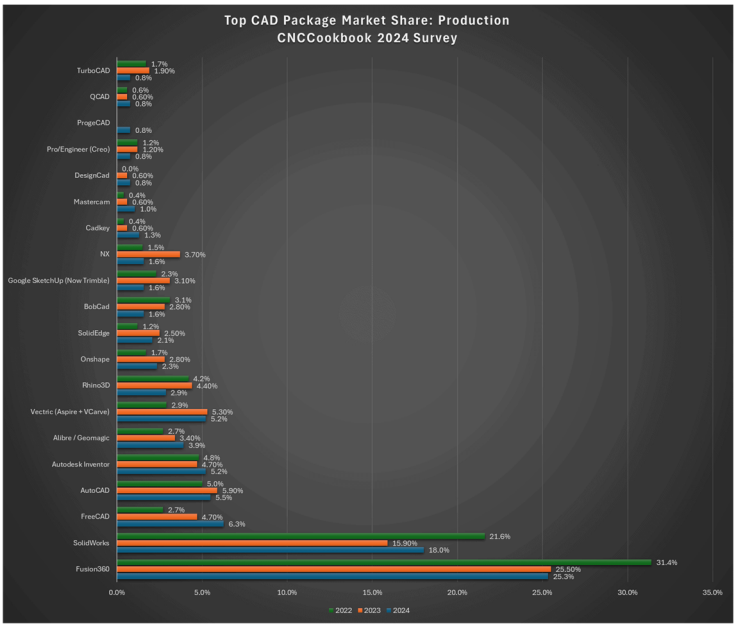

Fig. 1. Top CAD package market share.

There are other less popular or less capable tools that will not be covered in this paper but are worth mentioning. These tools are widely utilized in various areas, including those mentioned in this work. Some of these tools represent industry standards. For instance, SolidWorks is one of the oldest and most popular tools in the engineering world. It sets standards that other software often imitates or follows. It is also essential to note that some tools serve different purposes or have a narrow focus. For example, Ansys is best for analysis but not for modeling. Similarly, Abaqus follows Ansys trends and is mostly used for nonlinear analysis. Fusion360 and Inventor are from the same company that specializes in CAD. These two have similar appearances and similar tools, but they differ in various aspects such as generative design, nonlinear analysis, etc. Nonetheless, they are all applied to build 3D models of chosen products or other simple or complex structures, which can be visualized before real-world creation. The models can also be analyzed through various built-in features that provide essential results for product improvement or refinement [4].

3 Results and discussion

3.1 The use of engineering software in various fields

It may be surprising how food production and engineering tools work together. The most obvious reason is the design and structural analysis of equipment used in production systems, which can be used for safety analysis. The working environment must be free from accidents that could put human lives at risk. Software packages like SolidWorks and Fusion360 are excellent for analyzing structures and systems. They can detect weak spots in the structure, areas of potential failure, parts that need to be more firmly connected, and so on. By examining these results, the safety of agricultural environments can be improved, reducing unwanted accidents. These tools can also analyze how the production of a certain class affects system where or how many items must pass through a conveyor before failure occurs. They can be used to classify different products on a conveyor (Figure 2), check their flow, and identify potential issues. There are many areas where the use of engineering tools is required in the agricultural sector [5].

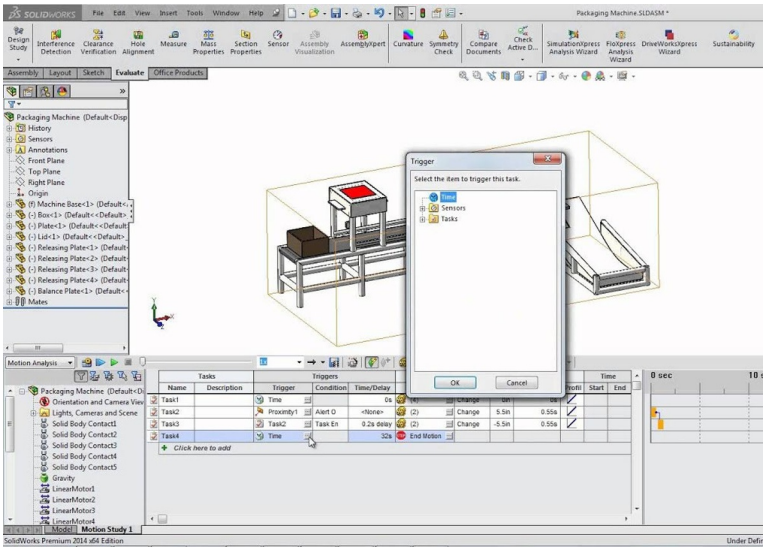

Fig. 2. Event-Based Motion: Packaging Machine.

Medicine is one of the main sectors concerned with human well-being. The use of engineering tools in this sector is no exception. Various engineering tools are employed for a wide range of tasks. For instance, improving existing tools is a key application. Modifying instruments is essential as technological advancements allow. Based on patient feedback, new tools can be developed. Many medical institutions still use tools created around the beginning of the 20th century, so engineering tools are critical for developing new apparatus and instruments. Another use of engineering tools in medicine is analyzing human parts. For example, these tools can assess the pressure exerted on teeth by braces (Figure 3) and predict how long it will take to realign the teeth [6]. SolidWorks can be used to analyse displacement of teeth with the external force.

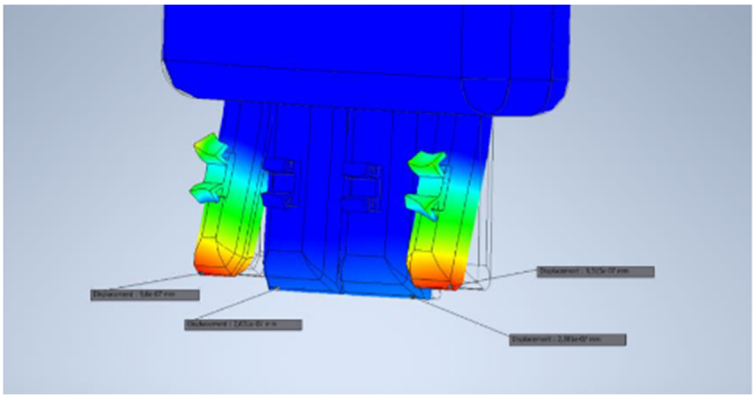

Fig. 3. FEA in medicine.

The robotics sector heavily utilizes engineering tools in numerous ways. These tools are used to build parts and assemble them with correct mates. Another use is analyzing mobility and maneuverability by moving parts of the structure. Assembled parts can be analyzed under various boundary conditions to examine changes in displacement, strain, stress, deformation, etc. Modern tools, powered by artificial intelligence, optimize structures using generative design, providing unconventional structural solutions for further tasks. These tools can also introduce motion to structures, analyze them in closed or dynamic environments, and simulate different scenarios before real-world use [7]. In the work [8] SolidWorks is used to move the structure with actuators (motors). With the extensive parts being dynamic the work tried to work out the torque on each joint as shown in Figure 4.

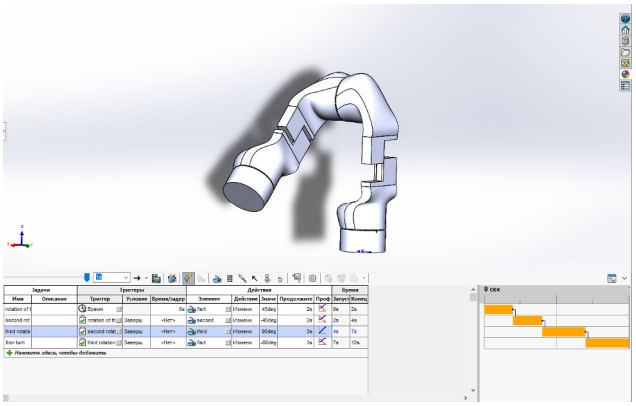

Fig. 4. Motion analysis of robotic arm in SolidWorks.

The educational sector is a primary user of engineering tools. Integrating disciplines from an early age will foster future generations that push boundaries. Currently, the use of engineering tools in schools is lower than in higher education institutions, as students often use these tools for projects and specialized classes. These tools educate students, but they could also be used for practical analysis in classrooms. Teachers and scientists use these tools in their projects. Although this sector lags behind others in usage, it should be a key provider of well-educated graduates [9,10].

When someone hears the term "engineering tools," it automatically relates to science. However, these tools are also used for entertainment. Some people use them for hobbies, spending their time modeling, designing, analyzing, etc. They can also create entertaining content like videos and images or build products and prototypes [11].

3.2 Future perspectives of engineering tools

It is clear that engineering tools will undergo massive changes over time. Some will disappear, some will dominate the market, and others will merge into new products. Predicting the future is difficult, but it is evident that these tools will evolve in ways mentioned here. With the advancement of artificial intelligence, common features of these tools will transform. Some tools already enhance their products with AI, and in the near future, these tools will become more intuitive and personalized. The analysis process will be simplified, errors reduced, and the capability to handle more complex structures will increase. The use of prompts to analyze structures, similar to how media content is generated today, may become possible. Although it is difficult to predict exactly, it is certain that engineering tools will become more capable and easier to use.

4 Conclusion

In conclusion, this work contains several paragraphs that present the use of engineering tools in various sectors. The main goal was to illustrate that many different sectors use engineering software packages. This work examined several sectors, including agriculture, medicine, robotics, education, entertainment, and business. It was concluded that some sectors use engineering tools more extensively than others. Different sectors utilize engineering tools in unique ways, meaning they have specific areas of application and more focused issues compared to other sectors. Lastly, this work also discussed the future perspectives of engineering tools and how their applications might change in the near future.

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