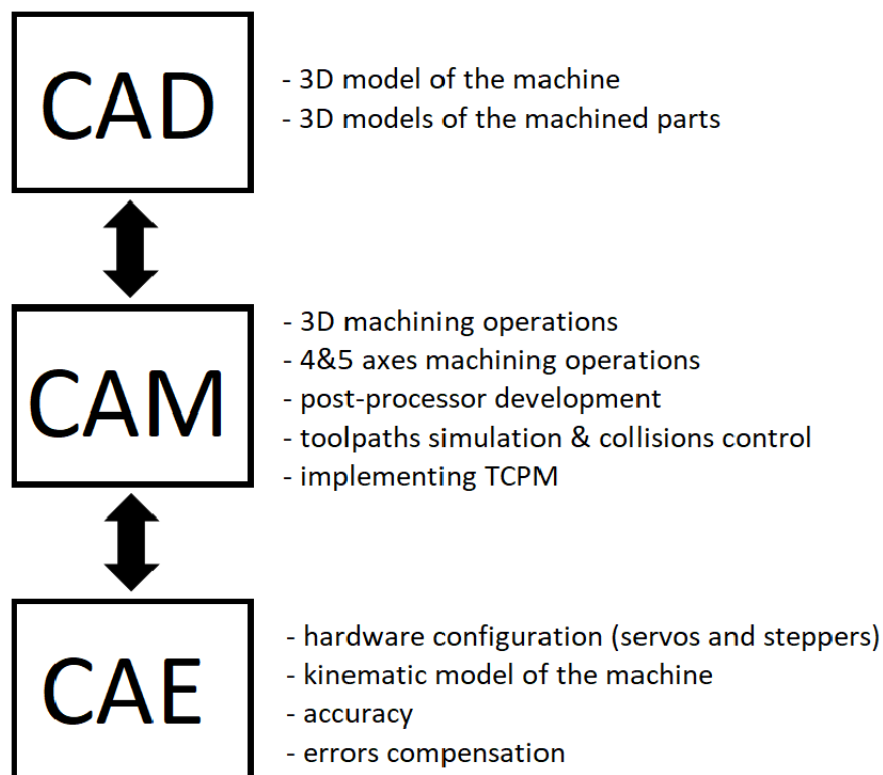


CAD, CAE and CAM Technology

In the machinery industry or automation industry, CAD, CAE, and CAM complement each other. Design with CAD and then manufacture with CAM. CAD is the design process using computer technology, CAE is the use of computer simulation to analyze physical problems, and CAM is the use of computers and computer software to control machines for manufacturing, usually suitable for mass-produced parts.

CAD/CAE/CAM are three functional types of industrial design software, representing computer-aided design, computer-aided engineering, and computer-aided manufacturing. CAD/CAE/CAM will be included in the basic functions of large-scale industrial design software suites. CAD emphasizes the design of the product itself from scratch, such as appearance, component position matching, material, etc. CAE for simulation, analysis requirements design, and CAM for 3D prototyping and fabrication purposes.



What is Computer-Aided Design (CAD)?

Computer-aided design (CAD) refers to the process of using computer software to create and analogize physical designs to show the appearance, structure, color, texture, and other characteristics of newly developed products. To put it simply, CAD is used to assist in designing and drawing. With the continuous development of technology, computer-aided design is not only suitable for the industry but also widely used in many fields such as graphic printing and publishing. It involves both software and dedicated hardware.

What are the Functions of the CAD System?

- ✓ Reuse of design components.
- ✓ Ease of design modification and versioning.
- ✓ Automatic generation of standard components of the design.
- ✓ Validation/verification of designs against specifications and design rules.
- ✓ Simulation of designs without building a physical prototype.
- ✓ Automatic design of assemblies.
- ✓ The output of engineering documents, such as manufacturing drawings, and bills of materials.
- ✓ Direct output of designs to production units.
- ✓ Direct output to rapid prototyping or rapid industrial prototyping machines.

What is Computer-Aided Engineering (CAE)?

Computer-Aided Engineering (CAE) is mainly used for simulation analysis, verification, and improvement of designs. With the rapid development of computers and 3D CAD in recent years, the proportion of CAE applications has become higher and higher, the difficulty of use has become lower and lower, and the number of users has grown significantly. Compared to CAD, CAE users require more physics-related knowledge to set conditions and interpret results. As for the mathematical methods used in the calculation process, such as differential equations, finite element method, finite volume method, etc., all can be handed over to the computer for processing.

Advantages of CAE:

- Save experiment cost and time, and speed up the development process.
- Physical quantities that are difficult to obtain experimentally can be obtained through simulation.
- It is easier to observe physical phenomena and changes in physical quantities.
- Product performance can be further optimized through numerical methods.

Disadvantages of CAE:

- Large-scale computing often requires expensive high-performance equipment.
- The interpretation of simulation results still requires the experience and knowledge of engineers to make correct judgments.

What are the Basic Processes of CAE?

1. **Step 0: Geometric model processing**- The 0th step is the processing of the geometric model. Why is it the 0th step? One is that this step will not use the simulation software. Mainly because the processing quality will greatly affect the solution, and sometimes it is quite cumbersome to handle. For example, in the fluid simulation, the inner space of the fluid flow is required, and the inner space is not especially drawn in general, so the inner space must be drawn according to the shell geometry. In addition, the complex features inside the model should also be simplified as much as possible. Although the pipeline has no complex features, if the model is not properly simplified, it will consume a lot of resources to calculate, and even the solution will fail.
2. **Step 1: Preprocessing** -The pre-processing is mainly to divide the mesh and set the simulation conditions. Usually, the geometry of the simulated object is quite complex, and there is no way to directly calculate the Governing equation corresponding to this geometry. To solve this problem, researchers cut this complex shape into multiple simple elements, which may be cubes, polyhedrons, etc., and then solve the equation on each element, and then obtain the corresponding value of the entire complex shape through mathematical operations. Simulation results. This step of slicing complex shapes into multiple elements is meshing.

3. **Step 2: Solve** - After completing the simulation settings, in the solution step, you need to tell the software what method to use to calculate the problem, including the grid discretization format, the selection of the solution algorithm, and so on. After completing the solution set, the next step is to wait for the software or the program written by yourself to solve it.
4. **Step 3: Post-processing** - Assuming everything went well and the software successfully calculated the answer, the next step is to look at the results. Use post-processing software to view information such as velocity fields, flow traces, etc. inside the pipeline. If it is necessary to improve and optimize the product, it can also be judged from the simulation results, and then the relevant configuration and simulation conditions can be improved.

What is Computer-Aided Manufacturing (CAM)?

Computer-Aided Manufacturing (CAM) is the process of manufacturing product components in which engineers make extensive use of product lifecycle management computer software. In other words, CAM is used to assist manufacturing, and the final output of CAM automatic programming is the CNC machining program. The 3D models of components generated in CAD are used to generate the CNC code that drives the numerically controlled machine tools. This includes the engineer selecting the type of tool, the machining process, and the machining path.

The Processing Steps of Computer-Aided Manufacturing:

Depending on the material and the software used, each step is a simple or complex strategy.

1. **Rough machining:** - The process begins with cubic stock or castings, which are roughly machined into the final model. Because it is processed in the horizontal direction, a stepped shape is usually obtained. Common strategies are zig-zag clearing, offset clearing, plunge roughing, and rest-roughing.

2. **Semi-finishing:**

The process starts with a roughed, uneven part, and the part is machined at a fixed offset.

3. **Finishing:**

Like semi-finishing, but with different starting materials.

