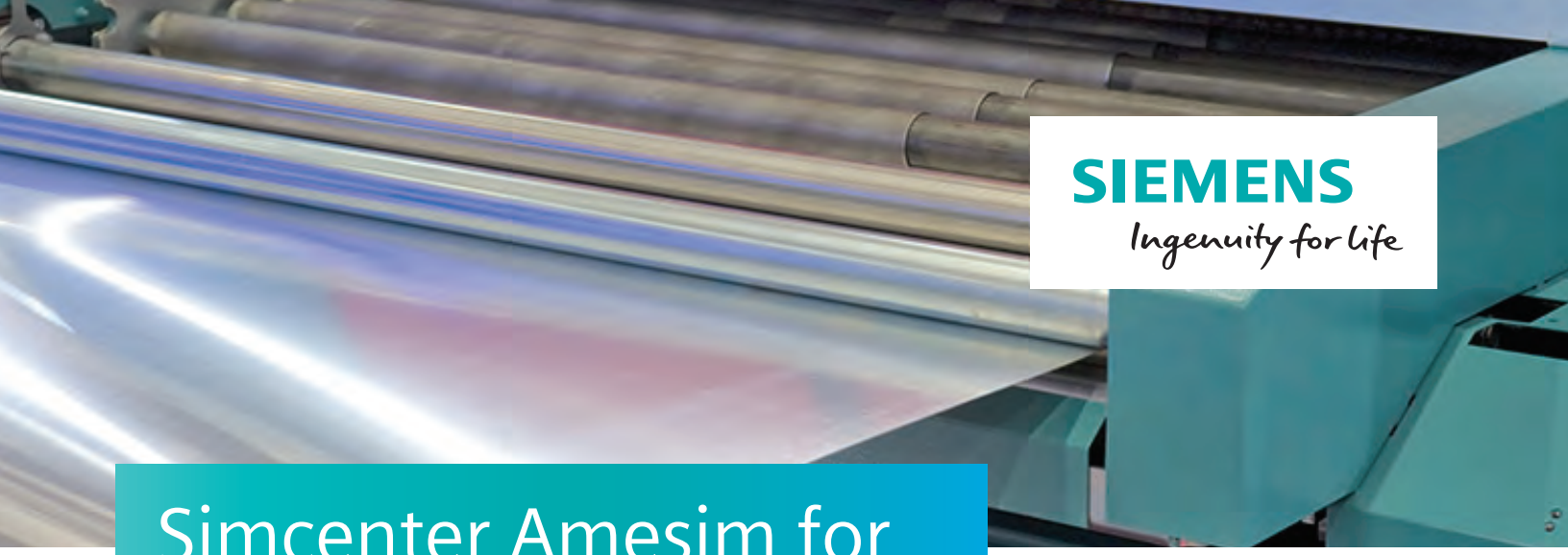


SIEMENS
Ingenuity for life

Simcenter Amesim for industrial machinery

Increasing productivity and energy efficiency

Benefits

- Enhance productivity and energy efficiency
- Accurately predict the multi-disciplinary performance of intelligent systems
- Make the right choices earlier in the design process
- Identify strategies for optimizing energy consumption
- Connect to controls design, helping you assess and validate strategies
- Easily share subsystem models and data in the extended enterprise

Summary

Developing industrial machines is a matter of finding the best compromise between various attributes, including:

- Productivity to reduce the unitary cost of production
- Accuracy to limit the reject rate
- Flexibility to quickly adapt the production rate to the current market demand
- Reliability to maximize production time and increase safety
- Efficiency to reduce the energy bill and comply with local environmental standards

To respond to the shift in purchasing decision factors and achieve adequate tradeoffs, the industrial machinery sector can benefit from investigating system and component design and creating new optimized architectures with model-based development. Using this approach, engineers can use system simulation for industrial machinery applications to counter the growing complexity of machines. It provides the unique ability to evaluate interactions between subsystems and simulate energy flows and develop control logics according to the design options for a virtual prototype.

Simcenter™ Amesim™ software from Siemens Digital Industries Software offers many analysis capabilities to optimize the performance and reliability of industrial machines at all stages of the design process, from multisystem architecture to detailed design of systems and components and system integration to control strategies validation. It supports your competitiveness objectives by frontloading design validation, avoiding costly physical prototype tests and helping you deliver high-quality and high-performance industrial machinery.

Simcenter Amesim offers a complete system simulation platform to model and analyze any industrial machine, allowing you to assess multidisciplinary performances. The software provides an extensive set of solutions that combine strong simulation capabilities and effective interfaces with leading computer-aided engineering (CAE) tools to represent both static and dynamic behaviors of any component or system in an intuitive graphical user interface (GUI).

Using Simcenter Amesim as a common system simulation platform for collaboration between original equipment manufacturers (OEMs) and suppliers, tier suppliers can virtually integrate their components in a larger system early in the development cycle, providing encrypted models to their customers to verify technological advantages. OEMs can simulate the integration of all supplier components and benchmark solutions to verify functional specifications and validate and rank performance attributes. This is valuable when

Simcenter Amesim for industrial machinery

Features

- Innovative and open platform for mechatronic system design and simulation
- Unique combination of ready-to-use validated physical libraries for a wide range of multidomain applications
- Efficient transient and steady-state simulations of complete industrial systems
- Built-in scalable and energy-conservative model that can be fine-tuned for complexity
- Powerful and straightforward analysis tools for the time and frequency domains
- Enhanced engineering knowledge and technology transfer

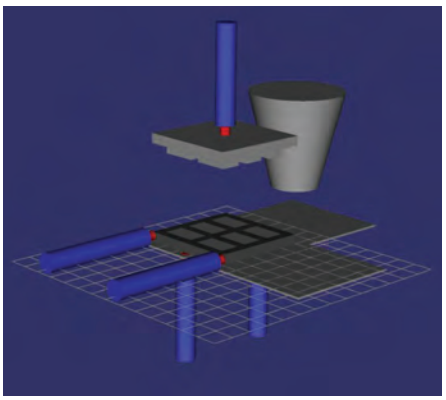
designing machines that need to rapidly and regularly be adapted to fit a new application or for customized machinery, for which customers require open specifications. Using system simulation development, not only can you shorten time-to-market, but you can also endorse the concept of customized equipment.

Boost productivity

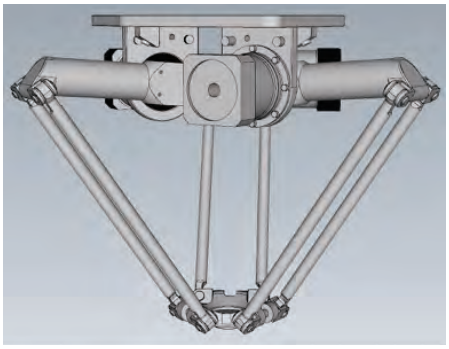
Industrial machinery is activated by multidomain components, such as actuation systems. They can be hydraulic, pneumatic, electric or combined mechanisms. With the Simcenter Amesim solution for industrial machinery, you can simulate various actuator technologies (hydraulic, pneumatic and electrical) coupled with mechanical moving parts.

The sizing of actuation systems in industrial machinery influences production speed as well as energy consumption. A new configuration of the system can lead to increased productivity and higher output rates for the end customer, thereby raising the overall competitiveness of the machinery in the market. Using the Simcenter Amesim solution, engineers can develop actuation systems and compare the curves of performance and energy use early in the design process. They can simulate various architectural layouts and component dimensions to achieve the best balance between productivity and power efficiency.

Component and system architecture and sizing can also determine the flexibility of industrial machinery usage cycles. Today, industrial machinery can be relocated to new factories and used for different line assignments or adapted for multiple products. Simcenter Amesim offers capabilities to anticipate these challenges by quickly predicting the consequences of a change in component design or production pace or adjusting to the waste and energy regulations of being in a new country.



Molding machine.



Delta robot.

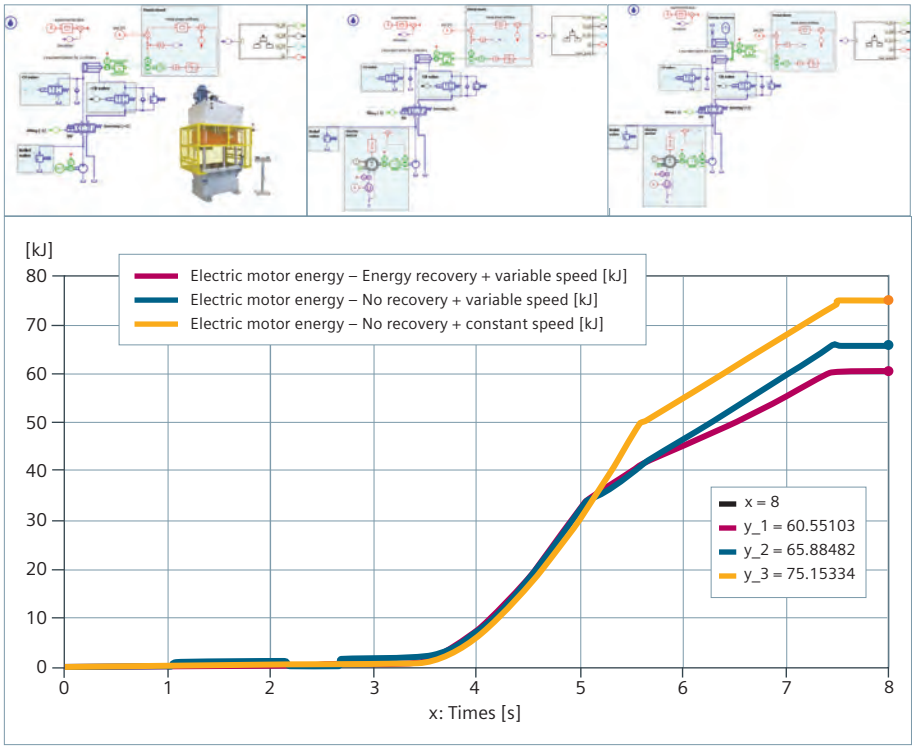
Reduce energy consumption

It is a necessity for manufacturers to enhance energy efficiency, both to secure long-term, cost-effective investment and comply with environmental regulations. Using Simcenter Amesim can help you optimize energy use for industrial machinery. By modeling the machine systems or components with Simcenter Amesim, you can easily examine how the energy is being consumed or lost. The numerous analysis possibilities spotlight the sources of loss and high consumption, such as pump efficiency, friction phenomenon, pressure limitations and braking systems. They can be quickly isolated for future design improvements.

Using Simcenter Amesim enables you to reduce losses and overconsumption by selecting the optimal design and machine parameters. The robust calculations behind the models enable you to

understand the impact of any design changes. Thanks to unique scalability that offers models with various levels of detail, engineers can easily enrich the physical content of the simulation models while keeping the level of fidelity in line with the design stage and data availability. They can analyze the dynamic performance of the global system after a design is completed or the architecture has been optimized to ensure the stability and reliability of the overall system.

Using the model-based development approach with Simcenter Amesim, you can reach substantial energy savings. By fine-tuning your components and systems, energy consumption can be significantly reduced, decreasing the total cost of ownership of industrial machinery.



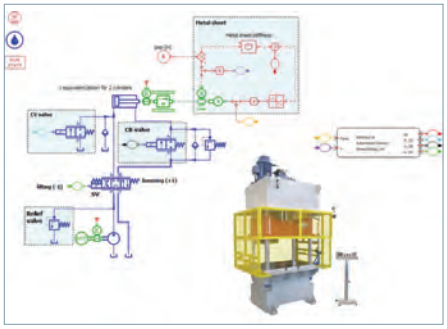
Hydraulic press with and without energy recovery strategies.

Frontload the design of control strategies

Simcenter Amesim for industrial machinery enables simulating tradeoff analysis between energy consumption, productivity and noise, vibration and harshness (NVH) in different operating conditions. It helps you define and evaluate energy management strategies and enables the frontloading and synchronization of the design of control strategies.

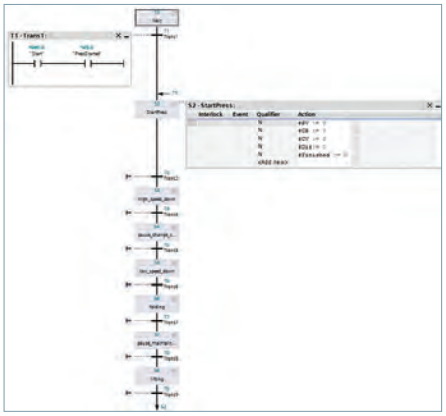
With Simcenter Amesim you get an integrated platform that provides realistic component and system models, enabling both system and control engineers to begin evaluation and validation phases early in the design cycle. This integration is done at different steps of the process – first with model-in-the-loop (MiL) or software-in-the-loop (SiL) and then with hardware-in-the-loop (HiL). Integrating plant models with a control model or code ensures the required accuracy as well as accessibility to variables needed for controls. Early evaluation and validation helps eliminate uncertainty in the development cycle resulting from late design process integration.

To validate the control system before machine prototypes are available, you can build validated real-time simulation of the behavior of the physical system and integrate the control system hardware and software with the simulation. By developing controls earlier, the solution enables you to obtain more mature control strategies for the calibration phase.



SiL simulation between a virtual Siemens SIMATIC S7 controller, emulated with PLCSIM Advanced.

It is possible to interface the Simcenter Amesim model with an HiL or emulated SiL controller by using Simcenter Amesim Automation Connect capabilities.

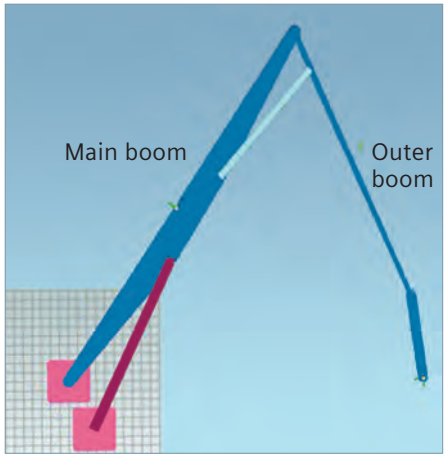


Emulated PLC instance in S7-graph language.

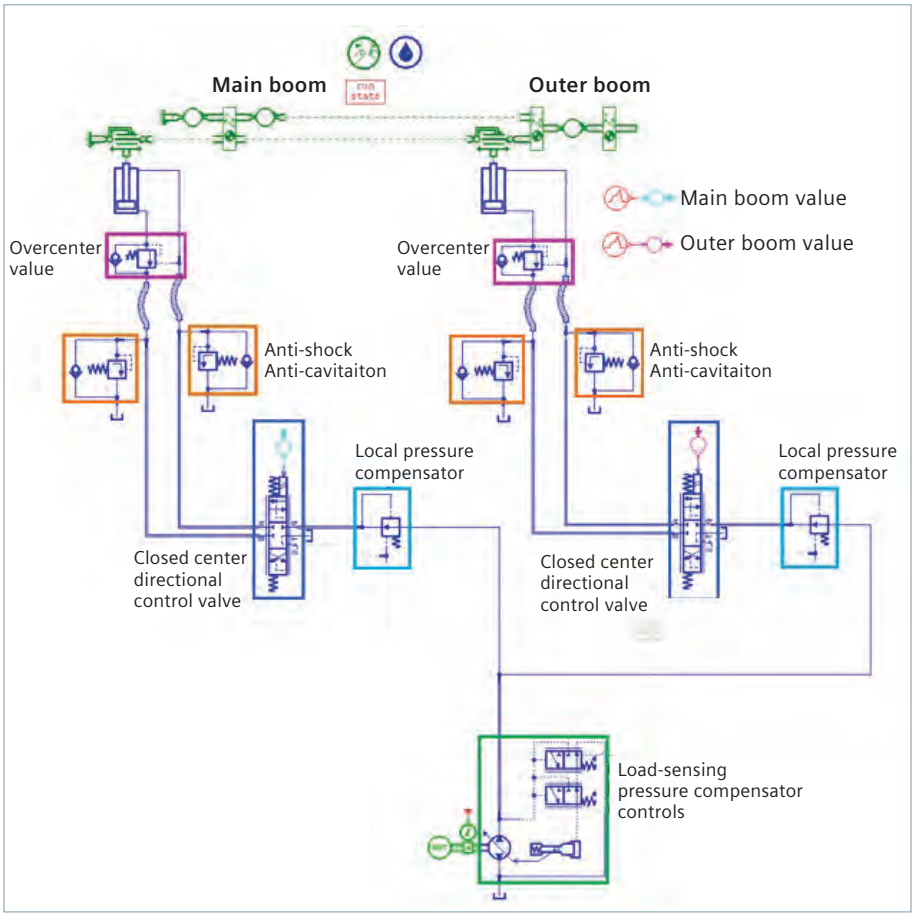
Predict maintenance by anticipating drawbacks

A key factor in industry is the availability time of a machine. Facing an interruption on an assembly line due to a machine failure can cause a severe decrease in productivity.

The use of model-based simulation working in real time in parallel with the physical components makes it possible to detect early deviations in the process. The user can then take appropriate corrective measures when the machine is not operating. This also prevents using the machine in abnormal operating ranges, which could lead to a failure.



Load crane mechanics.



Load crane actuation circuit.

Analyze noise, vibration and harshness risks

Long before sensor technologies are integrated into signal machine operating issues, industrial machinery manufacturers can curtail some quality risks by using the Simcenter Amesim platform to simulate critical scenarios. For their customers, who face fierce global competition, downtime can have costly consequences. To correct key component durability problems or unfavorable quality perception, Simcenter Amesim supports NVH analysis of the mechatronic systems as early as the concept stage.

Using Simcenter Amesim linear analysis functionalities, you can focus on NVH sources and act on related optimizations. Analyses can include excited system harmonics, frequency content of external excitation, natural frequencies and damping. It can also target the reduction of oscillations of moving masses and noise; for example, in the case of pressure ripples transmitted to hydraulic systems. Checking the sensitivity of design parameters in the frequency domain using Simcenter Amesim accelerates the implementation of rigorous solutions.

The Simcenter Amesim platform provides a better physical understanding of vibrations due to a combination of linear and nonlinear systems (dry frictions, variable stiffness, endstops, bearings, joints backlash). You can easily remedy noise and vibration issues generated by actuator behavior on mechanical structures or the coupling between fluid components, mechanical and electrical systems. By simulating vibration-related behavior of rotor dynamics of generators, motors, pumps, compressors, hydraulic or pneumatic systems in time domain, Simcenter Amesim helps engineers correct potential system response time disturbances and curtail risks of premature wear.

Based on the location where the machine will be installed, the overall manufacturing process, cost limitations and noise regulations, Simcenter Amesim enables manufacturers to apply the best tradeoffs for their industrial machinery. It grants a high level of confidence for successfully completing quality and environmental tests, even before the first prototype.

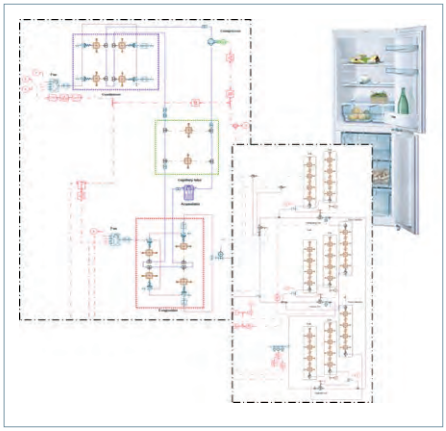
Improve thermal behavior of systems
Most industrial processes generate heat or thermal losses. Some heat phenomena will be stimulated intentionally; for instance, in heat exchangers, while others will need to be regulated or circumscribed; for instance, when resulting from friction in fluid actuation systems and mechanisms or losses in electrical motors and drives.

The solution enables you to model thermal phenomena in fluids and solids during energy transport and convection and study the thermal evolution by applying isothermal and transient heat transfer approaches. You can analyze and virtually design any type of fluid flow networks including thermal effects.

Thermal malfunction leads to faster wear and reduced performance. With Simcenter Amesim, you can observe the thermal behavior generated by electric motors, hydraulic actuation systems and mechanical frictions. By applying adequate cooling operation upgrades early in the development process, you can boost machine durability. Robustness will translate into less downtime, which leads to a stronger competitive position for both you and your end customer.

The Simcenter Amesim solution also enables you to properly size heat exchangers, estimate temperature variations over several working cycles and assess local temperature increases. The powerful calculations behind the Simcenter Amesim models allow you to quickly reach a higher precision than traditional empirical approaches. The overall cooling system can be sized to the closest-fitting requisites. From the heat exchangers to the cooling circuit and pump hydraulic network, all subsystems can be fine-tuned to decrease the overall fabrication costs of industrial machinery.

Because ambient conditions also impact operating temperatures, it is important to consider the exchanges generated between the two to develop the ideal lubrication and cooling systems. Environmental conditions may change because of the location of the factory but may also evolve to the two extremes during the year – a cold winter and hot summer. For instance, bearings in fans for industrial applications must withstand extremely varied conditions. Using Simcenter Amesim, you can undertake a thorough study of the thermal dynamic reaction of bearings, other components or the entire system. Simcenter Amesim provides a platform for designing lasting and energy-efficient mechatronic systems and subsystems for changing environments.



Refrigerator.

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