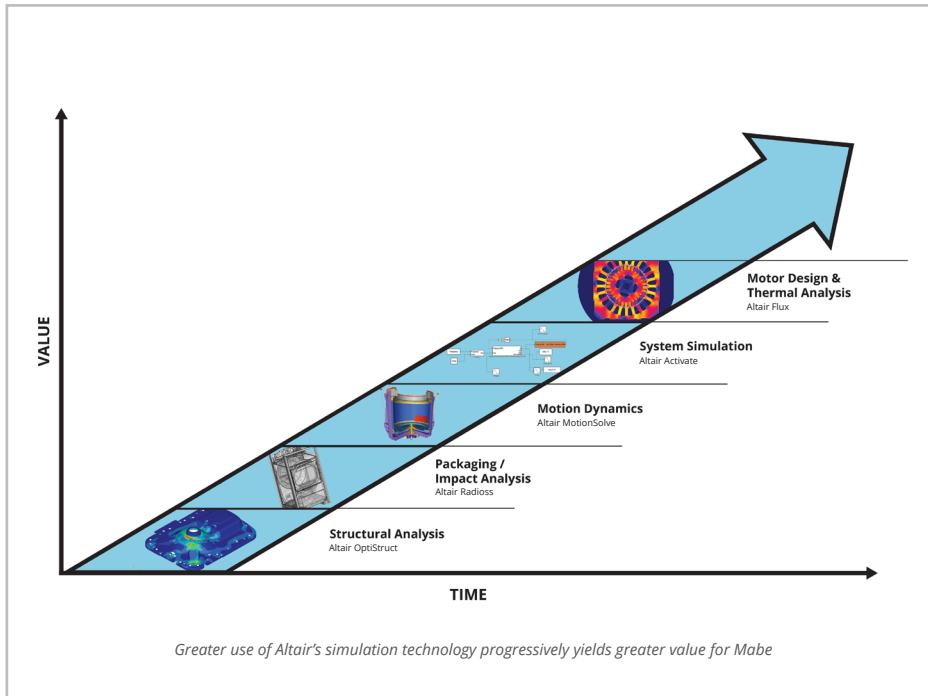


Mabe's Continual Performance Improvement of Washing Machines with a Multi-Disciplinary Approach



Background

Founded in 1946, Mabe is a Mexico-based international appliance company designing, producing and distributing a wide spectrum of home appliances such as washing machines, dryers, cooking ranges, refrigerators, air-conditioners, microwaves, etc. Martin Ortega, PhD, Senior Engineer at Mabe, estimates that use of Altair technology at Mabe has increasingly expanded since 2006 in order to develop better products, faster.

A Multi-Disciplinary Approach for Continuous Performance Improvement

Altair technology has enabled Mabe to increase the capacity of their washing machines by 35%, and the spin speed by 24% while reducing the cost per cubic foot by 10%. They have also improved the energy factor by 24%, and the water factor by 52%, while reducing the product development cycle time by 25%. By achieving these often-competing goals of improved performance, reduced cost, and accelerated time-to-market with new designs, Mabe has significantly improved its ability to compete against other appliance manufacturers.

As long-time simulation users, Mabe sought to build on several stages of continual improvement over the last decade. Beginning with structural analysis in 2006, Mabe used Altair OptiStruct™ to lightweight the machines as a way of reducing costs while maintaining high quality. Altair Radioss™ was used next for impact and drop-testing simulations to reduce the risk and expense of damages during shipping. Excellent gains were made, but the opportunity existed for increased value from Altair's multi-disciplinary approach, and Mabe fully leveraged the benefits derived from simulations of ever-increasing fidelity and scope.

To meet the rising demands and evolving engineering requirements of vertical axis machines, simulation of motion dynamics became important. Altair MotionSolve™ was used to simulate the motion dynamics of the washer drum, including the balance ring and the suspension system. An idealized motor model was used to define the various spin speeds



Industry

Consumer Appliance

Challenge

Improve machine performance by simulating subsystem interactions

Altair Solution

Activate for system-level simulation and for detailed 1D motor control model, with MotionSolve for 3D multi-body simulation

Benefits

- Energy factor improved 24%
- PD cycle time reduced 25%
- Market leadership in Latin America

of the washing machine during agitation and spin cycles. Next, this motor idealization was removed, consistent with Mabe's methodical approach toward ever-higher-fidelity simulations, and afforded by their shrewd use of the Altair HyperWorks™ Units licensing model. Specifically, Mabe began using Altair Activate™ for two purposes: (1) for detailed one-dimensional (1D) motor control modeling based on a block diagram approach and (2) as an integration platform for multi-disciplinary system-level simulation through coupling to Altair MotionSolve.

“With Altair technology, we are continually improving the performance of our washing machines and increasing our market share.”

Víctor Gonzalez,
Director of Product Engineering, Mabe

“We greatly value the breadth & depth of Altair’s technology – and the expertise of their consulting engineers. Over a period of 12 years, we’ve never hit any walls or show-stoppers. Every time we have wanted to expand our simulation capabilities, Altair has helped us do that.”

Martin Ortega, PhD,
Senior Engineer, Mabe

Outstanding Results

Mabe started using Altair MotionSolve to simulate the washing machine basket spinning at idealized speeds regardless of the load weight, torque and power required from the motor. The goal was to test for imbalances that would make it wobble or vibrate resulting in an undesirable “walking” motion. Once wet and heavy laundry is added, it starts to load up on one side of the washing machine creating an imbalance.

Washing machines typically need a balance ring designed to offset the imbalance of the laundry. The balance ring has dynamic characteristics of its own based on mass and location. To enable best performance, Mabe simulated it using parametric “what-if” studies including varying dimensions, mass, and locations.

Last but not least, Mabe started to model the motion dynamics related to springs in the suspension system. The suspension system is similar to that of a car, compensating as the wash load gets alternately heavier or lighter during the rinsing and drying cycles, respectively.

Using modern system simulation technology like Altair Activate fit well with Mabe's needs because motors aren't capable of producing precise amounts of torque instantaneously in order to make the basket spin precisely at a prescribed number of revolutions per minute (RPM). The motor torque will fluctuate slightly to try to maintain a particular speed and must dynamically ramp up and down over time as the agitation cycle changes to spin, dry cycle, etc. In fact, washing machine motors must speed up and slow down multiple times during a complete wash cycle. This co-simulation approach involving detailed motor control and motion dynamics together, allowed for more realistic, rather than idealized interactions between the motor and washing machine.

Looking to the Future

Consistent with their ever-expanded use of Altair technology, Martin and his fellow Mabe engineers have also started to use Altair Flux™ for more detailed motor thermal analyses to minimize risk of overheating during complete wash cycles, and to better understand the low-frequency electromagnetics. Also in the pipeline are developmental projects related to the Internet of Things (IoT). Having successfully grown to achieve market-share leadership locally in Latin America in 2017, Mabe is intent on expanding its share of the market globally.

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