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## The Limbs of Lumenhaus – Kollmorgen and Thomson Motion System Brings Virginia Tech’s Award Winning and Energy-Optimizing “Smart House” to Life

RADFORD, VA – Lumenhaus - Virginia Tech’s entry to the 2009 [US Department of Energy Solar Decathlon](#) and recent [first place winner](#) of the [2010 Solar Decathlon Europe](#) – is an 800 square foot energy-optimized “smart” home that leverages an active system of motion controls from [Kollmorgen](#) and [Thomson™](#) and to minimize the overall HVAC load on the house.

Working with Kollmorgen and Thomson, the Lumenhaus engineering team was able to implement the technology that met their exact performance needs without having to compromise on any of their design objectives to accommodate the available motion technology. “We needed components that could handle often harsh and changing environmental elements, readily accept a 3<sup>rd</sup> party control signal and that were flexible and easy to interface. We’ve been pushing the motion control system very hard, and the Kollmorgen and Thomson motion control solutions have absolutely come through for us,” says Robert Dunay, Director, Center for Research, Virginia Tech.

The thought behind the [Lumenhaus design](#) was to build a sustainable smart house with the ability to maintain optimal energy performance at all times. “When the weather is good the house automatically opens up and doesn’t use energy. Conversely, when the weather turns bad a system is in place that enables the house to protect itself,” says Professor Joseph Wheeler, Project Coordinator, Virginia Tech.

Lumenhaus epitomizes a [“whole building design” construction approach](#), in which all the home’s components and systems have been designed and built to work together to maximize user comfort with environmental protection. At its heart is an integrated environmental control system.

“The house has its own weather station with a ‘passive/active’ environmental control system to minimize energy consumption and maximize efficiency. In short, the weather station communicates with the control system, which in turns tells the Kollmorgen and Thomson motion system whether to open or close the house. When the house needs insulation, insulation screens close; when the house needs shading, shading screens close; and when the house needs security, the shade screens close without blocking natural ventilation,” explains Wheeler.

## **Making it Work**

Lumenhaus’ layered systems consist of a series of motorized shade screens and insulation panels that adjust to the changing weather patterns. The screens and panels can weigh up to 1000 lbs. each, and coupled with potentially highly dynamic loads from exposure to changing environmental elements, the tools that move them need to be extremely robust.

The shade screen assemblies ride on Thomson [60 Case® low profile round rail assemblies](#) with [Super Smart Ball Bushing® bearings](#), and are run by Thomson RapidTrak belt-driven [Linear Motion Systems](#) powered by Kollmorgen [AKM™ Servomotors](#). The insulation panels and shade screens serve as the “clam shell” that protect the house against the elements, and which are hung and moved by RapidTrak systems with Kollmorgen AKM servo motors. The house also uses Thomson [PPA PowerPac Actuators](#) as part of a photovoltaic array that tracks and generates power from the sun, and that automatically adjusts to accommodate for changes to the angle of the sun on a seasonal basis.

“Variable feedback provides a certain level of speed and power control, and in dabbling with the overall energy control we’ve been able to move the panels at up to 300 in. per minute, if needed, using just 1.5 amps of power. Using such a small amount of energy to operate these panels can have a big impact, as it means we don’t have to turn on HVAC systems,” says David Clark, Student Team Leader, Virginia Tech. “Of course power needs vary depending on weather conditions and the changing dynamic loads from high winds and changes in wind direction, so sometimes we need to tweak the power to optimize performance; the bottom line is that we’re able to do so in such a way as to control consumption and maximize efficiency.”

Lumenhaus constantly monitors weather patterns and automatically adjusts the shade screens and insulation panels as needed, so Virginia Tech engineering students used a 1-10 [Micron® NemaTRUE Planetary® Gearhead](#) from Thomson inserted between the Kollmorgen AKM Servomotor and track drive to increase torque potential, and to help slow motor down so panels don't move too fast. "Generally speaking we don't need 10,000 different stops, we just need to reliably get to the right position," says Clark.

## **Manual Override**

As with all things automated, there are times that demand a manual override. Lumenhaus utilizes an iPhone and iPad as the interface element, along with Kollmorgen [S200 Servo Drives](#) with digital and analog inputs, to help manually override the building control system. "The building control system takes the information it receives from the iPhone or iPad, interprets it from 1-10, then sends a low voltage signal out to each servo drive (0-10 v). When the drive receives the information it interprets it into an exact position count, and then sends the screens and insulation panels to the correct position," explains Clark.

The iPhone and iPad automatically orient the floor plan of Lumenhaus, and with swipe of a finger on the iPhone or iPad not only can users override the control system to reorient the screens and panels, but they can also be used to remotely control any number of aspects of the house, including locking or unlocking doors. For example, the front door of Lumenhaus features an RFID tag that enables remote control to open or lock remotely with the touch of a button – so if one needs to give a neighbor access to the house to let the pets out they can do so from any remote location with cellular phone service.

## **Potential Application, Today**

"What's really interesting about some of the concepts brought to life in Lumenhaus is that it gives us a picture of how, on a smaller scale, existing residential and commercial buildings could be made more energy efficient by retrofitting them with smarter louver-type systems that not only shade but also insulate. For example, the ability to have a control system that automatically responds to and even harnesses what the weather gives through means such as blinds, shades and shutters that know where the sun is and can adjust accordingly is potentially pretty significant when it comes to minimizing HVAC use and power consumption," says Dunay.

## About Kollmorgen

[Kollmorgen](#) is a leading provider of integrated automation and motion control systems and components for machine builders around the globe, with over 60 years of motion control design and application expertise.

Through world-class knowledge in motion, industry-leading quality and deep expertise in linking and integrating standard and custom products, Kollmorgen delivers breakthrough solutions unmatched in performance, reliability and ease-of-use, giving machine builders an irrefutable marketplace advantage.

For more information visit [www.kollmorgen.com](http://www.kollmorgen.com), email [contactus@kollmorgen.com](mailto:contactus@kollmorgen.com) or call 1-540-633-3545.

## About Thomson

With more than 60 years of motion control innovation and quality, [Thomson](#) is the industry's premier producer of Linear Ball Bushing<sup>®</sup> Bearings and Profile Rail Bearings, 60 Case<sup>™</sup> Shafting, ground and rolled Ball Screws, Linear Actuators, Gearheads, Clutches, Brakes, Linear Systems, and related accessories.

Thomson invented the Linear Ball Bushing Bearing in 1945, and has set the standard ever since with an unsurpassed set of mechanical motion control solutions serving global commercial and aerospace & defense markets. Thomson Industries, Inc. has facilities in North America, Europe and Asia with over 2000 distributor locations around the world.

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