

# Highvoltage.dk Engineers Lightning Protection Solutions with SpaceClaim

## THE CHALLENGE: CREATE AND MANIPULATE COMPLEX MODELS IN-HOUSE FOR BETTER CONTROL

When complex structures such as wind turbines are struck by lightning, the discharge may interfere with the electronic equipment within the turbine. Engineers must ensure that the most vulnerable areas of the turbine are not exposed to potential strikes that could cause the turbine to fail or sustain damage. As the cost of commercial-scale wind turbines runs in the millions, being able to optimize the design is critical.

When approaching the simulation and analysis of turbine designs, Highvoltage.dk has to model the physical behavior to gain knowledge of the system without empirical validation. To perform these simulations, Casper Falkenstrøm Mieritz, Consulting Engineer, uses COMSOL Multiphysics® simulation software. Before SpaceClaim®, Casper had to discuss the CAD pre-conditioning with the customers, which added time and costs to the process and took some of the control out of the hands of Highvoltage.dk.

## SPACECLAIM REDUCES MODELING TIME BY 50 PERCENT AND INTEGRATES WITH COMSOL THROUGH LIVELINK

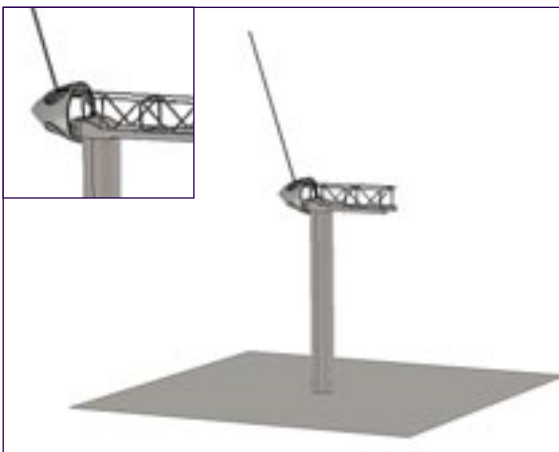
To analyze the real physical structures, customer geometry must be simplified to the appropriate level of detail for the numerical methods involved. Customers typically send Highvoltage.dk fully-featured CAD geometry that is unsuitable for meshing. SpaceClaim's automated model simplification tools allow Casper to remove irrelevant details such as bolts, nuts, and small edges. Once the model is de-featured, Casper leverages SpaceClaim to further refine the geometry and move it directly to COMSOL through the LiveLink interface to SpaceClaim, which fuses direct modeling and multiphysics in a tightly integrated environment.

*"We used to spend a lot of time and resources in making our customers deliver the CAD drawings with the required level of detail, which was a time drain and ineffective. Now with SpaceClaim, I can continue to make edits and perform simulation as a continuous loop until we're satisfied with the results. This has*

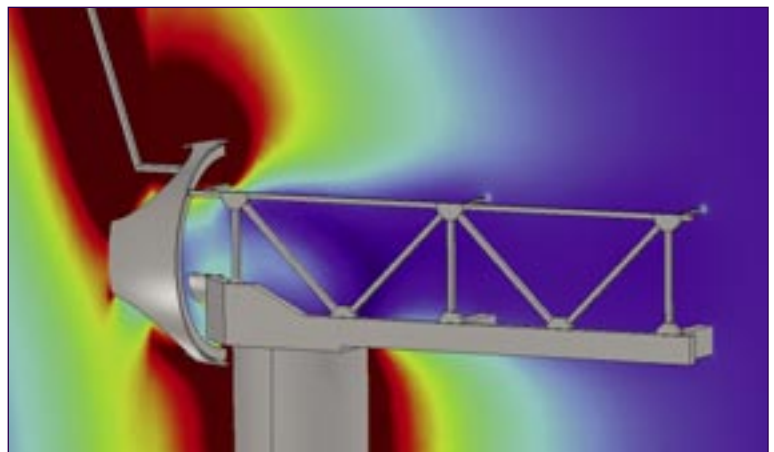
## ABOUT HIGHVOLTAGE.DK

Highvoltage.dk is a Danish consulting engineering firm with expertise in lightning protection and high voltage engineering. The company, founded in 2005, tackles complex problems such as general high voltage design engineering for the power industry, lightning protection concepts and findings for wind turbines, and high voltage material tests.

The engineers at Highvoltage.dk are experienced users of numerical analysis tools to simulate magnetic and electric fields, current distribution, and lightning attachment points. Casper Falkenstrøm Mieritz is a Consulting Engineer at Highvoltage.dk with significant expertise in simulating high-energy electrical behavior and predicting the electric and magnetic fields in complex structures, such as wind turbines.



**Figure 1:** To compute physical conditions within wind turbine nacelles, we use SpaceClaim to precondition the comprehensive CAD drawings. The generic nacelle is drawn entirely in SpaceClaim, and has been used to illustrate the opportunities for potential customers.



**Figure 2:** The magnetic field within the nacelle structure is used for specifying the necessary level of protection of panels and installations. The calculated magnetic fields of more than 30kA/m corresponds to a situation where the turbine is struck by a 200kA lightning strike.



**Figure 1:** To investigate the magnetic field and determine the requirements for protection at a certain location in the nacelle, a volume of interest is added to the model. The volume could represent a control panel, in which protection might be crucial. The magnetic field is in this case illustrated by an isosurface plot where each color represents different values of the magnetic field.

*saved us at least 50 percent in time to model.”*  
Casper Falkenstrøm Mieritz, Consulting  
Engineer, Highvoltage.dk.

High voltage or high current testing involves the development of a test plan, the numerical modeling and actual testing, and the evaluation of the results. The technical documentation of the test results includes design guidelines for the customer’s product, final test reports, and the translation of requirements into application specific descriptions. Including very realistic visual representations of the product and recommendations created in SpaceClaim has made a big difference to Highvoltage.dk’s communications with its customers.

*“SpaceClaim is very easy to use and understand. With SpaceClaim we are able to create 3D drawings that clearly represent our recommendations and make it much more*

*understandable to our customers. SpaceClaim has definitely improved the visual content of our work.”* Casper Falkenstrøm Mieritz

Additionally, SpaceClaim has enabled Casper to take on small design projects to help customers optimize the design of a small part, as an example. Prior to using SpaceClaim, these new opportunities were cumbersome as Casper did not have the right tool – he would have to ask the customer to draw the part.

Through Finite Element Analysis (FEA), Highvoltage.dk is able to handle a broad range of complex tasks including modeling of lightning attachment points on large wind turbines, current distribution and electric potentials surrounding sacrificial anodes on offshore installations, and the design of high voltage switchgear.

*“Lightning protection of wind turbines has become mandatory and increasingly our customers look to Highvoltage.dk to determine the necessary shielding of panels and cables and foresee current amplitudes in shielded cables and other components. SpaceClaim has changed our business for the better and enabled us to move more quickly and be more creative in our approach to optimizing electrical applications”*

Casper Falkenstrøm Mieritz  
Consulting Engineer  
Highvoltage.dk



150 Baker Ave. Ext., Concord, MA 01742 USA  
Tel: +1 978.482.2100 Fax: +1 978.369.5864