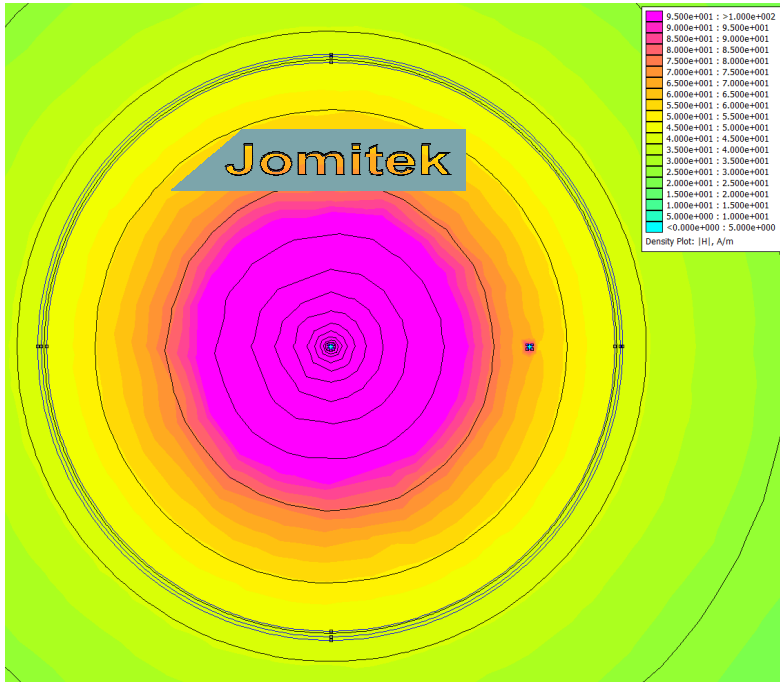


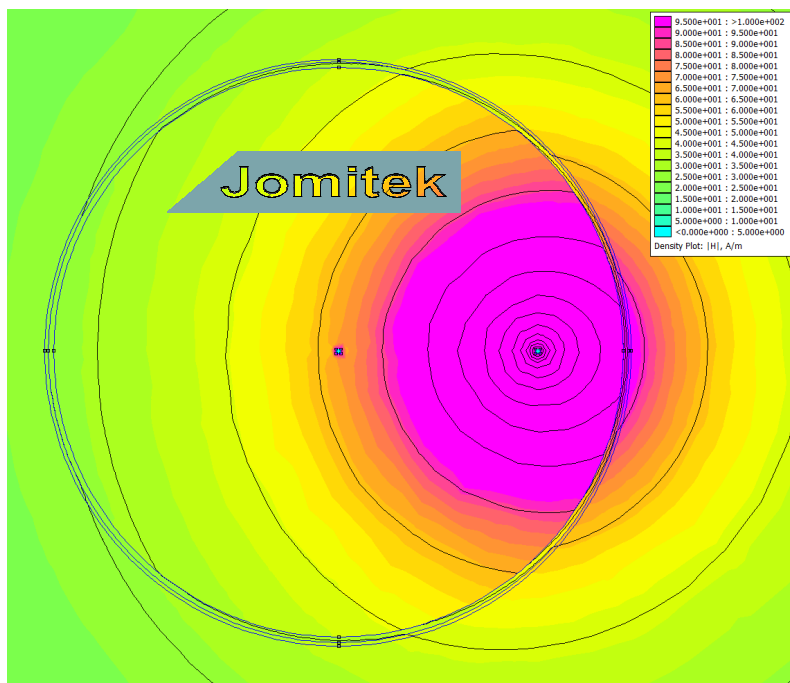
Sensitivity vs. current path through structure

The following simulations are used to exemplify the properties of the Jomitek Lightning Sensor Advanced sensitivity variation vs. the current path of a lightning strike through a circular magnetic steel structure, e.g. a wind turbine tower. The structure is 5 meter in diameter, and with a wall thickness of 50mm. The steel is assumed to have a relative permeability of 25.

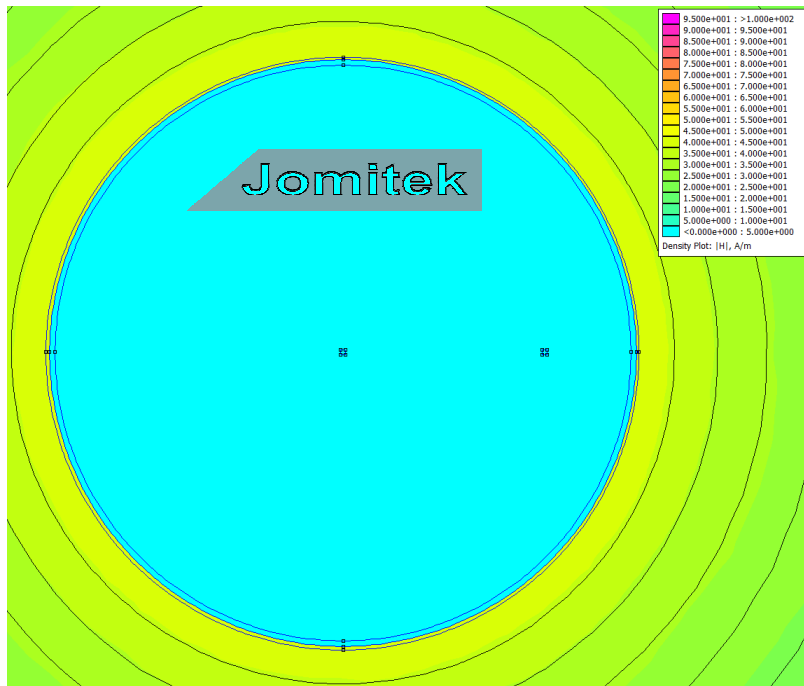
Direct strike, 100% through center down conductor



Direct strike, 100% through off-center down conductor



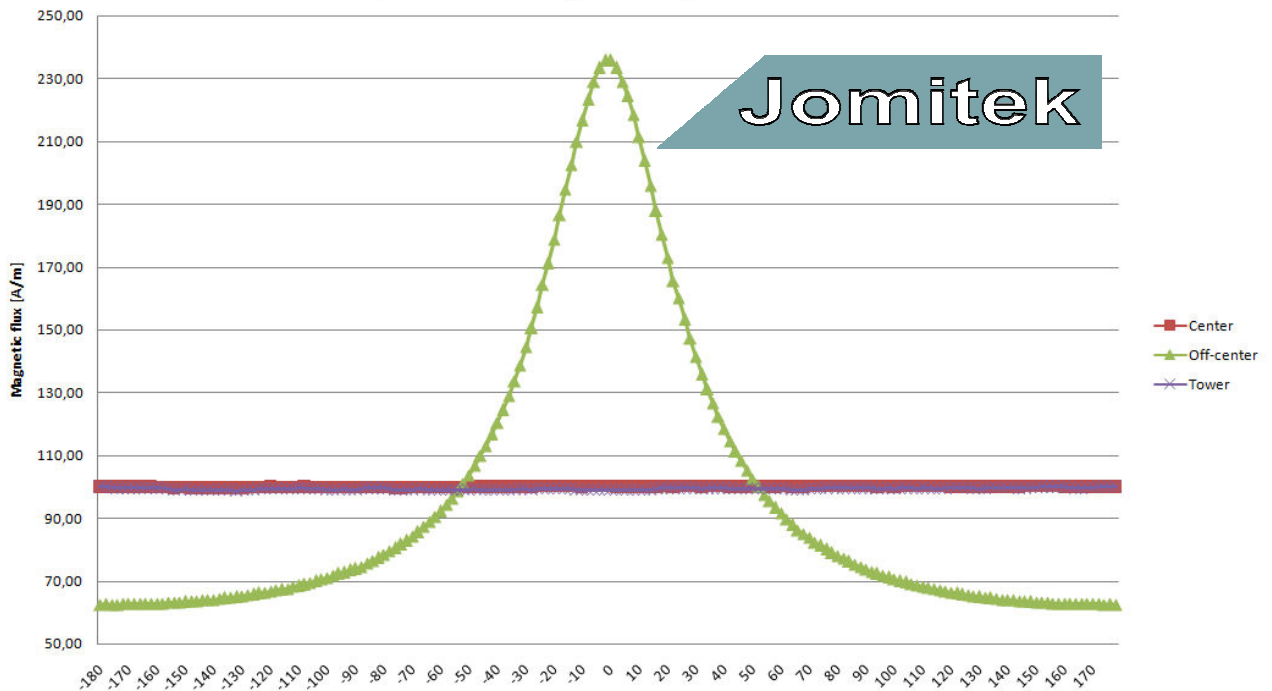
Direct strike, 100% through tower structure



For the 3 scenarios the amplitude of the magnetic field a few centimeters from the outer surface of the wind turbine tower has been plotted, please see below graph. This distance is the position of the Lightning Sensor Advanced internal sensor components, when mounted on the surface of the structure.

Magnetic field strength example for lightning amplitude detection

Same current being conducted through center conductor, off-center conductor or through the tower itself of a wind turbine
 Magnetic flux vs. mounting position in degrees on outside of turbine



The off-center situation presents a differing amplitude to the other two scenarios. Here please note that the simulated off-center situation is a quite extreme worst case scenario. What should be further noted, is that by mounting the sensor $\pm 45-50$ degrees from the internal position of the down conductor, all 3 scenarios are basically identical, which supports high precision requirements.

Besides the added criteria (or optimization option) of mounting the LSA $\pm 45-50$ degrees away from an off-center down conductor, it should be noted that inviting a significant part of a lightning current inside the tower structure requires thorough consideration in terms of shielding requirements from induced currents/voltages into internal circuit boards, etc..

By having the primary lightning current run down through the outer tower wall, the magnetic field inside the tower is ideally reduced to zero (see the 'direct strike, 100% through tower structure' figure), and thus also the risk of damages via induction.

In conclusion to the expected sensitivity variation:

With a setup similar to a real world wind turbine, an expected worst case variation is within $\pm 10\%$. If an internal down conductor is placed significantly off-center, the sensor must be mounted $\pm 45-50^\circ$ away from the 0° line defined from the center of the tower through the internal down conductor, to achieve this level of precision.