SIMULIA

systems alcan

ALCAN Systems

Case Study

DASSAULT SYSTEMES

Challenge:
Developing innovative phased array antennas that are compact, lightweight and low cost

Solution:
Electromagnetic simulation helps engineers design and optimize even very complex arrays

Benefits:
Fast, accurate simulations of array behavior validate the design and help solve any issues

ALCAN SYSTEMS DEVELOPS INNOVATIVE 5G-READY ANTENNAS WITH SIMULIA

As the world becomes increasingly connected, 5G and satellite broadband offer wireless connectivity to previously inaccessible regions and environments. These technologies promise to revolutionize fields from communication and entertainment to industry, logistics and healthcare by allowing high-speed data just about anywhere – 5G alone is expected to enable up to $664 billion in services by 2028.[1] Taking advantage of this potential will require new kinds of antennas that can meet new challenges.

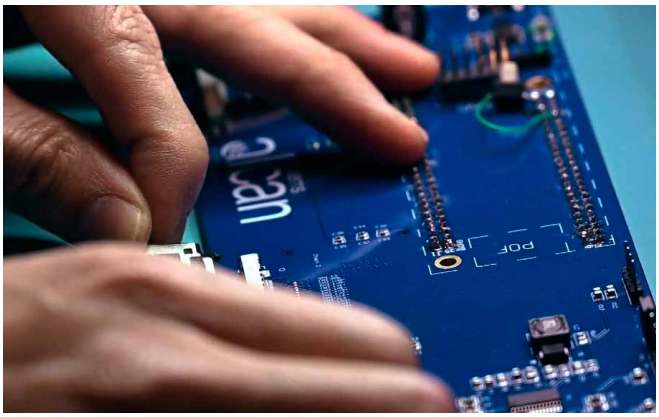
ALCAN Systems is a start-up developing liquid-crystal-based phased-array antennas. These antennas allow high-performance electronic beam-steering in a compact, lightweight package. This will allow ground-based terminals to follow satellites across the sky, or let a 5G device stay in contact with the base station. ALCAN Systems uses electromagnetic simulation with SIMULIA CST Studio Suite to design and model its antennas and optimize their performance.

The challenge: Developing innovative antennas for reliable high-speed data links in challenging environments

Previous generations of mobile technology tended to use omnidirectional antennas and similar designs that simply provided coverage from as many directions as possible. However, these designs won't work for the future of satellite broadband and millimeter-wave 5G.

For satellite internet to work properly, the end-user—who may be on the ground, in a moving car or boat, or even an aircraft—needs a constant line of sight to the satellite. The satellite itself moves across the sky, and the user may be repeatedly handed over from satellite to satellite. The distance from the ground to the satellite means that a very high directivity and gain are needed to maintain contact without excessive power use.

The problem for 5G is similar. The omnidirectional approach used by earlier generations is not appropriate, especially for the very high frequencies used in millimeter-wave 5G. At these frequencies, spanning from 24 GHz to 53 GHz, loss from waves passing through the air and other materials is much higher. Again, very high gain is needed to compensate for this without pushing the power consumption too high. Ahmed Akgiray, Chief Technology Officer of ALCAN Systems, says "... If you multiply frequency 10 times, you suffer 100 times the loss in air. To be able to overcome this loss you need gain. So that means you need beam steering. You need directed high-gain beams but you need to be able to change their location."



Mechanically steering a dish antenna is one approach to achieve this level of gain and beam steering, but that would be heavy and bulky. Electronic beam steering is an alternative, using an array of smaller antennas. Precisely adjusting the phase of the different antenna elements causes interference that shapes the fields into a tight beam.

ALCAN Systems was founded in 2016 with a mission to create a low-cost smart antenna system for cellular and satellite communication. They developed an innovative new approach using phased- array antennas, using liquid crystal display (LCD) technology to precisely control the time delay and phase shift between the elements. LCD technology can be made much more compactly, efficiently and cheaply than traditional phased arrays, and can be manufactured on the same production lines as LCD televisions. "Usually you would be looking at hundreds of watts, if not kilowatts, and the cost would be in the tens of thousands of dollars, if not more," Akgiray says "And what we are trying to do is bring it under $1,000 and looking at power consumption of maybe 20-30 watts."

"As an engineer, you have to have confidence in what you are simulating in your tools, in the results you get from these tools," Akgiray continues. "We have validated results for our applications, for our structures, for what we are trying to do. We know it gives us reliable results so I don't have to second guess myself all the time."

— Ahmed Akgiray, Chief Technology Officer, ALCAN Systems

> "There are many challenges in the design phase of any phased- array or any complex RF system," Mehmood explains. "And we have also seen unexpected results which once you put them into the simulations, you understand more. The easy way to check is actually to go back to your simulations, perhaps go a little deeper, change some parameters and discover the problem."
>
> —Arshad Mehmood, Head of RF Engineering, ALCAN Systems

THE SOLUTION: ELECTROMAGNETIC SIMULATION OF ANTENNA ARRAYS

Compared to older antennas, the phased-array antennas are much more complex. Arshad Mehmood, Head of RF Engineering at ALCAN Systems, explains, "There are no more simple antennas which you can design using just pen and paper or simple equations. They are really a complex system. And to develop phased-array antennas you need not just simulations, but extensive simulations."

To manage this complexity and develop effective antenna arrays, ALCAN Systems turned to Dassault Systèmes SIMULIA and their electromagnetic simulation tool SIMULIA CST Studio Suite. "In an RF design we have a component level design, but then different components also have to come together and still work in a certain way you want them to. CST Studio Suite has all these solvers, which you can use at different levels, at the component level, or even at the system level," Mehmood explains. "I don't know if any other software provides such an extensive number of solvers."

Akgiray adds, "In the area of phased-array antennas, we push the tools basically to their maximum limits, right? And here, being able to work with SIMULIA has been awesome. We have this really good working relationship with SIMULIA where we have said 'I can do this but I want to be able to do this.' And they are usually very responsive."

The results from CST Studio Suite were accurate and gave ALCAN Systems engineers trustworthy insight they could rely on. "As an engineer, you have to have confidence in what you are simulating in your tools, in the results you get from these tools," Akgiray continues. "We have validated results for our applications, for our structures, for what we are trying to do. We know it gives us reliable results so I don't have to second guess myself all the time."

THE RESULT: A COMPACT, LIGHTWEIGHT AND INNOVATIVE NEW ANTENNA SYSTEM

Using simulation, ALCAN Systems developed a phased-array antenna product based on LCD technology that they are focusing on marketing. "As a start-up, you are limited in time. You're limited in money. You're limited in human resources. So you always want to have more of those. We are focusing on one product and getting it out to the market, but obviously, we have roadmaps for addressing different use cases," Akgiray says.

Simulation helped them meet challenges during the design process and identify the root cause of problems that emerged. "There are many challenges in the design phase of any phased-array or any complex RF system," Mehmood explains. "And we have also seen unexpected results which once you put them into the simulations, you understand more. You know the reason behind them – perhaps some loss or resonance or another phenomenon. The easy way to check is actually to go back to your simulations, perhaps go a little deeper, change some parameters and discover the problem."

REFERENCES

[1] 5G Services Market Size, Grand View Research https://www.grandviewresearch.com/industry-analysis/5g-services-market

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