

Backgrounder:

Sierra Wireless Mobile Communications Laboratory

A world-class antenna pattern measurements research facility

**Sierra Wireless Inc.,
Canada Foundation for Innovation, BC Knowledge Development Fund, Western Diversity,
Simon Fraser University
plus donations from Satimo US Inc., and Near Field Systems Inc., and Agilent**

SFU lauds the spirit and aspiration of Sierra Wireless Inc. for their championing of links between research and industry. Sierra Wireless Inc. seeded the funding for a world-class antenna pattern measurement facility through a major donation, and have endowed a professorship in mobile communications at SFU. The Sierra Wireless Laboratory comprises a radio-shielded chamber, which is housed in a 5 meter cube, a planar scanner with an open chamber, and associated specialist measurement and processing equipment. These are co-located with other communications research.

This investment from Sierra Wireless is to help:

- improve the quality and level of research in mobile communications in B.C.;
- create new knowledge and new high-capability graduates;
- continue to develop and links between industry and research.

Antennas: the basis of radio science

This investment has established a world-class antenna pattern measurement facility. Antennas are usually the most visible component of wireless communications and electromagnetic sensing. Antenna design governs the performance of a communications system.

With the radio spectrum becoming increasingly crowded, its shared use is a dominant issue. The use of multiple antennas allows the transmitter and receiver to adapt their patterns to changing radio environments, and maintain the wanted signal above interfering signals. Even without interference, the link quality is vastly improved through using properly designed multiple antennas.

Wireless communication is a green technology because the amount of energy required to transfer information is incredibly small when using radio waves. Nevertheless, owing to the billions of terminals worldwide, small differences in the antenna performance can make massive differences to the energy cost of our networks. Newly developing radio science, in particular the design of multiple antennas, means better link performance as well as massive energy savings.

About pattern measurement

An antenna's pattern is its most complicated fundamental property, and is usually represented with a large set of numbers. It is the directional intensity – in some cases this is in all directions, like a lantern light, and in other cases it is directional, like a torch beam. Radiowaves are polarized, meaning that there are two 3D patterns per antenna connection, or port. The patterns of an antenna change with the radio frequency and they also change as objects move close to the antenna, such as a head near a cellphone.

Accurate pattern measurement is an extremely complex process. It involves precision robotics, radio frequency electronics, large scale data acquisition, complicated mathematical transformations and computing, and other signal processing, all working together in order to estimate vector 3D spatial patterns at different frequencies. For proper characterization of the radiation pattern behavior, tens of millions of measurements are taken from multiple, precisely defined spatial locations and orientations, and at multiple, precisely defined radio frequencies. These measurements must be executed in a closed environment which suppresses reflections of the radiowaves used for the measurements, and which is shielded from all other radiowave signals. The raw measurement data is processed to derive the basic pattern data and then

mathematical manipulations derive other useful properties of the antenna. The facility can measure a pattern within several minutes, making it ideal for evaluation, research and training.

Value to Industry and Driver of Research

The soaring public demand for wireless services is also a driver for a very broad range of new scientific research – new materials, new physics, new mathematics, new computing techniques, new sociology, new bio-medical effects, new commerce and new business models. It's clear that wireless technology uses the natural sciences, but it also needs more than this. In the natural sciences, we observe an apple falling, or an atom disintegrating, and we try to explain it. In the “unnatural sciences”, such as information theory, we develop new concepts from abstract logic, and apply these concepts to make a new, and unnatural, capability – a wireless system. For implementation, we use the usual hardware with an obvious physical presence, but we also use less visible things such as electromagnetic fields and waves, micro-electronics, computer programs, and digital algorithms.

Launching from a century of progress, wireless is only just getting started. There are hundreds of wireless companies in B.C., and very few of these can afford pattern measurement equipment. Such companies can have a new advantage through the SFU facility. Graduate students will be in strong positions to contribute to existing, or helping to start new, wealth-creating companies.

The Sierra Wireless Lab fosters partnerships between SFU and industry with a two-way flow of knowledge. The presence of the Laboratory has already led to interactions with many companies, from household names to new start-ups. Our research in radiowave propagation, communications signal processing, and antenna design and evaluation methods, has been impacted strongly by Sierra Wireless Inc. The results are being used by industry for new and improved products.

Value to Society

Communications technology has transformed how we do business, how we provide and receive public services, and even how we socialize. We depend on wireless connectivity, not just between devices, but also between people, to databases, and to the internet. Wireless is in everyday items from personal terminals to remote alarms. Wireless systems are embedded in our daily lives, from retailing and banking to transport and the way governments function, and if the wireless infrastructure collapsed, it would be immediately catastrophic. The ultimate outcome of research and training in wireless is economic wealth creation through “hi-tech” manufactured exports, new and improved infrastructure and services, including public sectors such as health and safety, and better businesses.

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