A doctor who knows the neurons of computer

Dr. Robert Moses

President and CEO, PCI Geomatics

I was fascinated with geography from the age of 10. I would spend hours looking at maps of the world, I learned the flora and fauna, history and natural resources depicted within those old atlases. As I got to university, that passion faded and I fell in love with biology. I got a degree in biology and medicine and practised general and emergency medicine for about 7-8 years. It was a noble profession.

One day, I realised that though I was doing well economically, biology really wasn't what I wanted to do. It took a lot of courage and about a year of intensive introspection before I took up artificial intelligence. I spent about four to five years learning about computers, cognitive science and sociology. I worked with a team and we created a music synthesiser, which was very innovative for 1979-80. We invented a methodology to allow the computer to provide musical scores based upon parallel processing.

The next advancement that we made was the creation of an algorithm for the music industry; a kind of neo approach to music. We didn't realise how innovative it was for its time, as parallel processing was just beginning to burgeon at that time. During this period, I was managing a recording studio and working with talented musicians and composers. It was fun. We actually built and sold ten of the McLeyvier systems. However, we ran into economic difficulties and eventually I closed that enterprise. The McLeyvier musical instrument was unique and is now displayed in a Canadian museum.

McLeyvier system won a design award of excellence and I was encouraged by the Canadian Government to continue my work with parallel processing. I was awarded a research grant and in due course, we created a super computer; essentially a parallel processor. Syntronics, my original computer science company, sold a few of those. Along the way, hardware technology advanced to such an extent that computer manufacturers came up with desktops that were faster than my parallel processors. At that point I decided to move out of the hardware business and move into the software business. So, I stopped working on parallel processors and transferred the technology to India with the help of my friend Dr. Jiten Saha and

CDAC, Government of India, which in turn led to the PARAM series of parallel processors being built in India, founded on the techniques that we had developed in Canada. These systems are still prevalent today.

COLD WAR AND REMOTE SENSING

By that time, the Government of Canada was looking at our group as an innovative one. This was in early 80s when Cold War was at its peak. I received a research contract from the Canadian Government to take satellite images and process them in parallel. The North American Governments were interested in estimating the food resources of China, Russia, and other countries. At that time Syntronics joined PCI, which was an offshoot of the Canada Centre for Remote Sensing. We married the two technologies and the net result was a software package called EASI/PACE used by some governments to analyse food resources and geopolitical situations. Our EASI/PACE product was able to work on much less costly systems and eventually it was packaged for the desktop market. This product was later re-branded as Geomatica, and today these same clients use it to sell essentially the same information to the commodity markets.

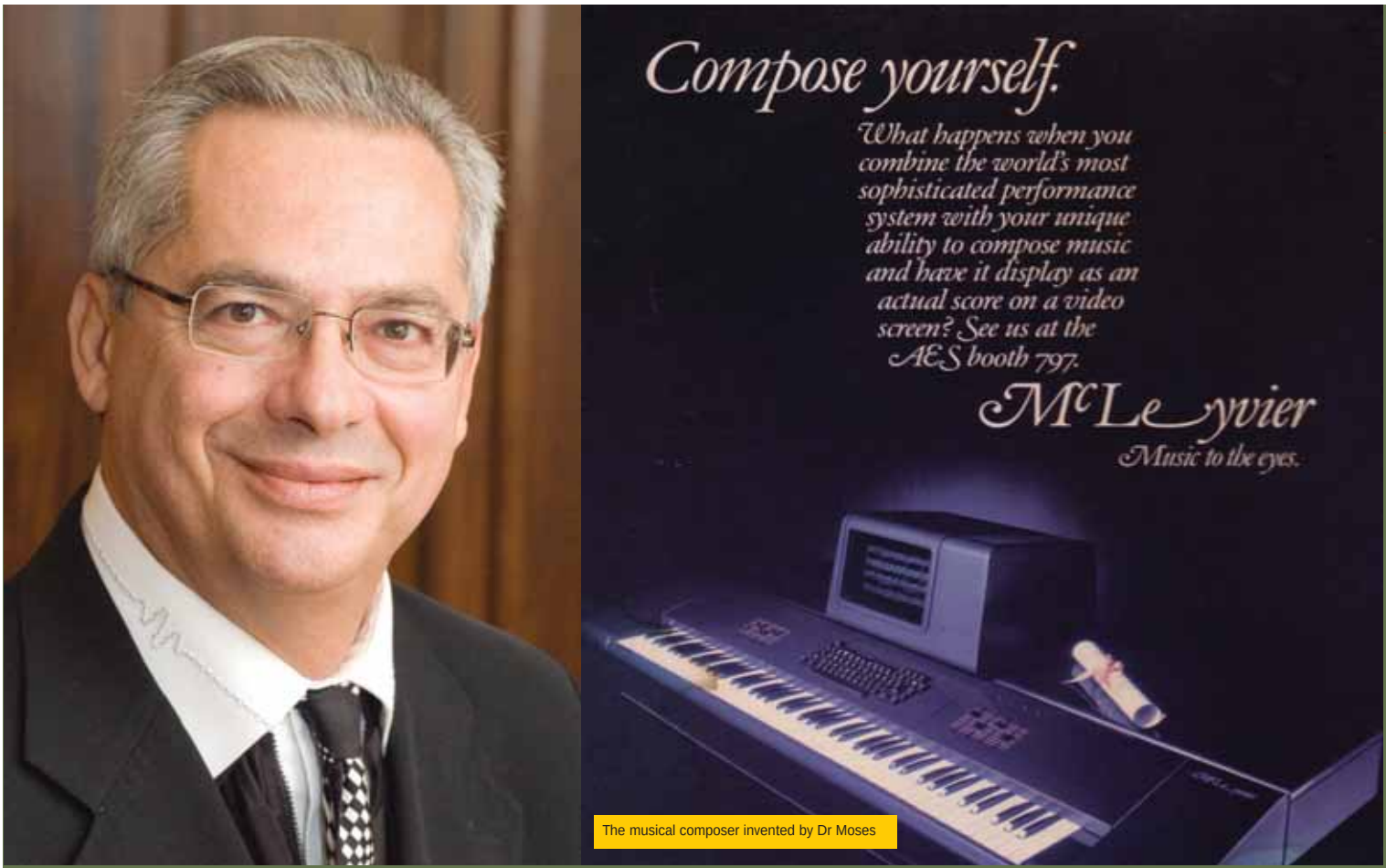
Dr Moses with the then Premier of Ontario Bill Davis (1981)

In 1990, we dropped the name Syntronics and I took over as the President of PCI Geomatics. At that time, proprietary software systems were the norm for image analysis. In cooperation with the Canadian Government, we re-tooled Geomatica as a non-proprietary software, to be able to run on any hardware or software platform - AJAX, UNIX, Windows etc. We found that many software platforms were not interoperable. To address the interoperability issue, we were able to devise a computer language that could be programmed to run on various hardware/software configurations. Now, this is commonplace. With those advances, we began to penetrate the global market. We became world class in know-how and intellectual property in the desktop software domain. Today, our users hold 20-30 thousand licenses around the world. The largest market in the world at that time was the US military and intelligence establishment, and because of the sensitivity of satellite data within governments at that time, we really couldn't penetrate that market as an indigenous Canadian company.

UNIQUE POSITIONING

We have done well since 1990. The entire market was comprised of only 100 million dollars and a few satellites back then. Along with companies like ERDAS, ENVI and ERMapper, we formed an industry that slowly grew with the market. About 10 years ago, we realised there would be hundreds of satellites and instead of putting our resources into only creating algorithms, we began to put our resources into automation and parallel processing. We received large contracts from several governments to perfect that technology and we finished it two years ago. We understood where the bottlenecks were and we realised that it was not the sensor or the algorithms but the throughput of the system and the huge manual interactions required to create a final product. Basically, we componentised all of the software in Geomatica. We broke it into pieces like Lego, and we used advanced computer programming languages such as .Net, Java, and C++ to enable a user to string together these components for specific application workflows. That was a state-of-the-art. That started to elevate us in the technology game and our competitors are still trying to catch up to us. Since then, we have patented a hardware-software system much like my past super computer by using advanced accelerator hardware. It is Web enabled and has enterprise architecture. It has a screen, speed and flexibility so that a client can use it to customise their production workflows.

This is not on the desktop solution; this is a real aerospace advanced engine which takes terabytes of satellite images and ingests, corrects and processes them in a highly automatic fashion. This is a disruptive technology within our industry. We have already shipped several of these systems and we intend to sell one to the Indian government as well. We have clients all around the world and I am confident that we are uniquely positioned to lead in the remote sensing image analysis area. We are the first



The musical composer invented by Dr Moses

in the market with this disruptive technology.

Our vision for the future is to be heavily Web-based. With the confluence of the Web, computer power and modern ways of programming, the cost of utilising the data and the ability to unlock the richness of all the information within the image is becoming more affordable. Soon, this will emerge in a big way, and it will become ubiquitous much like the Web.

Similarly, I believe satellite sensors, along with these advanced methods to analyse complex data in a simple and effective manner, will make remote sensing and image analysis ubiquitous, especially when it is used to diagnose the health of our planet, for food scarcity and for biodiversity issues.

There is a huge potential market which is approaching 1-2 billion dollars today and is forecasted to be growing to 5 billion dollars in the next five years. Some people say it is closer to 10 billion dollars. The image centric or geo-imagery part of the geospatial market is exploding at a fast rate; much faster than the traditional vector based systems.

PARAM, the super computer

THE OGC CONNECTION

In 1994, I realised that one of the reasons that PCI couldn't penetrate certain markets was because of all the proprietary formats and systems housed in silos, none of which were interoperable. The Canadian, US and the Western European governments were demanding that software and systems become more interoperable. So, when David Schell approached me with his concept of setting up a consortium to create open standards to allow for the interoperability of systems, I readily agreed. PCI is one of the six founding members of the Open GIS Consortium. Our hope at that time was that this would allow smaller companies to penetrate into places where large companies had their own proprietary formats. Over the next decade, this concept took off in a big way. The huge advantage in this concept of open standards and interoperability was for the large systems integrators like Rolta International, or Lockheed Martin who were able to offer more cost effective solutions to their client base. Hence, the systems integrators started joining the consortium, which in turn drove down costs. Government institutions in Europe, US and Canada promoted the concept of open GIS consortium which was

(from left to right) David Miller, COO eSpatial, Dr. Moses, President and CEO of PCI Geomatics, Michéal Martin, Irish Minister for Enterprise, Trade and Employment, and the Canadian Minister of Natural Resources, Gary Lunn during the inauguration of on-demand mapping centre at NRCAN in 2006.

eventually renamed the Open Geospatial Consortium. Today India and China are joining the OGC bandwagon. In the last two years, I've come to the realisation that most of the burning issues of our time are global in nature, and without interoperability, different levels of governments cannot work together to mitigate against the devastating effects of the ever increasing natural disasters. The world is banding together to form GEOSS-like frameworks to work on issues of climate change, soil degradation etc… To be able to work in an efficient manner, we need interoperability. I felt strongly about this in 1994. David Schell and his team's vision have been validated over the past decade. Recently, OGC unveiled a Global Advisory Council and I was fortunate to have the trust and confidence of the OGC Board of Directors who elected me as its Chairman.

ISSUE BASED TECHNOLOGY

PCI is trying to get away from selling products based only on bells and whistles. We have outgrown the concept of technology for technology sake. We are shifting our focus to outcome driven technology. One of the advantages of remote sensing technology is that it can diagnose the problems of the planet. We need to look at the huge volumes of imagery archives along with current images of Gaia (Earth) to begin to diagnose its ills and devise mitigation strategies. Much like in medicine where I started, a patient comes to you because one of his organs is infected or not in balance, and we perform a series of tests. Based upon the results, the physician makes a diagnosis and decides upon the best course of treatment. When you look at Gaia, we don't know the unintended consequences of our actions. Today, we see that many of the issues of the world are caused by us. How do we fix them? We need to have multiple accurate diagnostic tools and therefore Earth observation tools are essential.

Throughout history, we have made assumptions that people lived in harmony with their environments based on the innate cultural wisdom of the millennia and genetic evolution. I am not sure if that is true, but it is certainly a valid argument. There are other factors we have to bring into play here. There were always wars of destruction even a hundred thousand years ago, even in scarcely populated Europe and India between various tribes. There has always been deforestation and environmental degradation. Indeed we wiped out several species, the mammoth for instance, in our drive to feed ourselves. As our population grew, this environmental degradation accelerated. It's not that we lost our wisdom; it's that there is an imbalance between our intellect and nature. In each period, every two thousand years, the two separate a bit, but like pendulums they come back together. It is a cycle. I hope during the current period, there will be a coming together of the feeling of oneness with the universe and technological and societal progress. I believe that every individual should expand and work to preserve the flora and fauna of the planet. Definitely, to do that, we need technological progress. Otherwise, the poor villager will always starve and fight with his neighbour. Since the enlightenment which happened about 200-300 years ago, our intellect has superseded our feeling of oneness. The standard of living of humanity has immensely improved and therefore we mustn't throw the technology baby out with the bath water. We must continue to work for the betterment of the world, and also try to ensure we give our planet to our children and grandchildren in a state where they can also see the wonder of planet Earth.

THE PARALLEL - NEURO AND COMPUTER SCIENCES

My work keeps me going because I love what I do. In the geospatial industry, people are educated, kind and global in perspective. In the intervening years since I practiced medicine, I have come to have a huge expansion of consciousness of the world standing on the platform of the industry that I am in. I am involved quite deeply with the scientific community of North America in more ways than one. It is quite exciting to find new ideas and then actually apply them to computer science. As the Vice-Chairman of Ontario Centre of Excellence (OCE), I am promoting this concept of neuroscience. The OCE is a combination of government, industry and academia which aims to transfer technology from universities to companies.

There has been a huge explosion in the understanding of how our brains actually function. Our brains are not computers, they do things very differently and our brains have taken millions of years to evolve. I can pick up a picture and point out a tree. I don't do a mental calculation to come to that. I just come to that. Brains are very slow compared to computer circuits but unlike computers humans can effortlessly recognise objects. We now realise that there are 2-3 of these pathways and methodologies that I believe may be easy to programme into computers.

In the brain, there are several mechanisms that could be applicable to our industry in the areas of image recognition and information extraction from images. I believe that neuroscience concepts applied to computer science will be the next disruptive technology in the coming 3-4 years. This may be my last expedition, but you ever know. ■