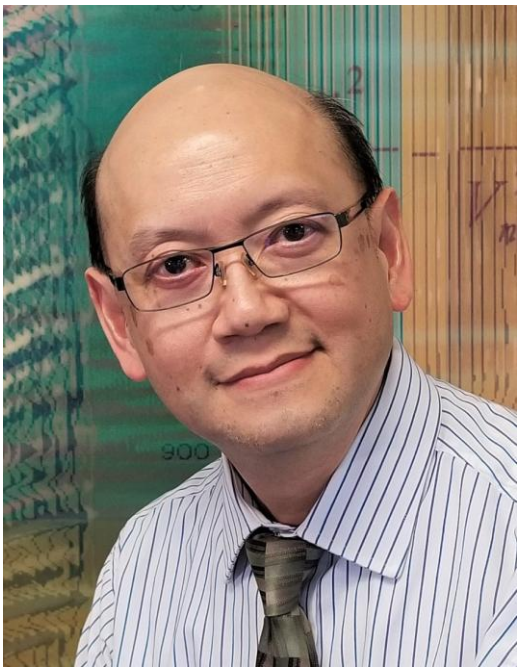
“Do not let your zeal subside, a diligent hand will prosper”

An interview with Mark Ng

INTERVIEW COORDINATED BY SATINDER CHOPRA



Better known for his research work in signal processing, Mark Ng, an electrical engineer turned geophysicist, has had a long and interesting career spanning more than four decades. He began his R&D career at Sefel Geophysical, later joining Geo-X Systems Ltd. as a research geophysicist. He briefly taught in China before returning to Geo-X, continuing through its transitions to Divestco Inc. and Z-Terra North, where he remains a senior geophysical researcher. His work centers on seismic signal processing and migration techniques, with six of his papers earning SEG and CSEG recognition. Outside of research, he enjoys playing piano, composing music, and photography.

The RECORDER was lucky to get an interview with Mark so that the broader CSEG community could get to know this remarkable person a bit better.

Mark, tell us about your educational background, work experience, and what you are engaged in these days.

I graduated with a B.Eng (distinction) from Concordia University in 1981 and an M.Sc. from the University of Calgary in 1983, both in electrical engineering specializing in signal processing. Since then, I have been working as a geophysical researcher and application programmer in the R&D group. I am still actively engaged in R&D work which I find very challenging.

After receiving a B.Eng (with distinction) and an M.Sc., both in electrical engineering specialized in communication and signal processing, you decided to pursue a career in geophysics. How did that happen?

In the early eighties, when I was finishing my thesis on short-time Fourier analysis and synthesis with autoregressive modeling (similar in part to the present-day Gabor deconvolution), my academic supervisor professor, Spencer Nichols at the University of Calgary, told me that my work could be directly applied to the geophysical field. So, I marketed myself, and I received a job offer from Dr. Arnim Hasse of Sefel Geophysical six months before graduation. I saw it as an open-door invitation for me.

You have worked in R & D at Sefel Geophysical, Geo-X, Divestco, and now Z-terra North, essentially doing cutting-edge research and putting it into applications. What kinds of problems did you work on?

My career began at Sefel Geophysical, where I worked as an application programmer from 1983 to 1985. After that I moved to Geo-X Systems Ltd. as a research geophysicist in Calgary. In 1991, Geo-X not only allowed me to take a ‘sabbatical’ leave but also supported me as I was invited to teach digital signal processing at the Changsha Normal University, China for a year. I returned to Geo-X in 1992 and worked until the processing department was sold to Divestco Inc. in 2006, and then on to Z-Terra North in 2020. I have continued to work there since that time as a senior geophysical researcher. My research areas include seismic signal processing, multiple attenuation, AVO preserving interbed multiple elimination, migration of multiples, various migration techniques, inversion, and high dimension interpolation methods.

Why did you choose the research areas you are currently involved in?

Since I am working in the geophysical industry, many of the research topics that I worked on were market-driven as they must generate a financial return for sustainability reasons. I learned that from my first mentor in my early career years. Additionally, attending SEG and GeoConvention conferences, and exchanging ideas with world-class geoscientists, sparked my interest in tackling different geophysical problems

You decided to take up the teaching offer you got in China in between. What made you decide to come back?

I always have a desire to contribute to society. Since the industry and people have blessed me so much, I feel I need to give back a little of what I received. So, I took a year off to teach over there. As a matter of fact, that year my family and I spent in China greatly enriched our life experience. I should not say I ‘spent a year’; rather I ‘gained an extra year’ of life there.

Delivering a talk at the Geoconvention

Sometime back, a colleague of a national oil company asked me why it takes such a long time processing a 3D seismic volume. Together with acquisition and interpretation, it takes almost two years to use seismic to generate one or more prospects for drilling. How do you react to that comment?

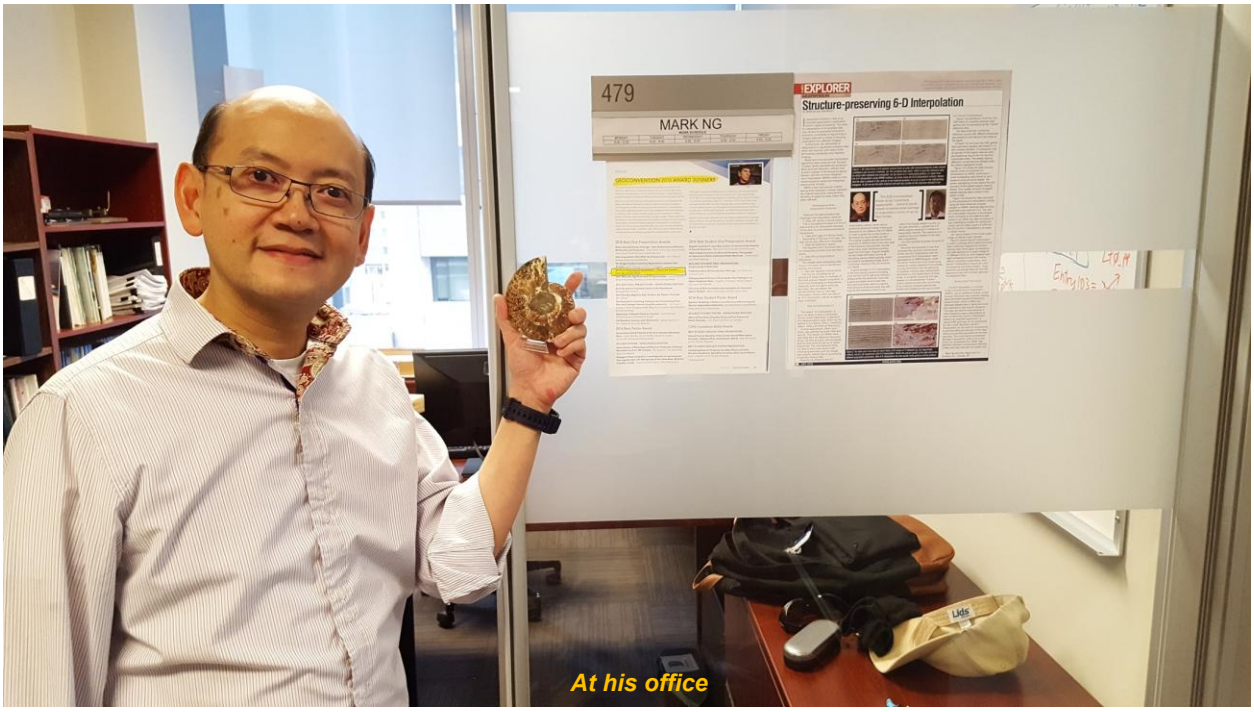
Many procedure steps and contractors are involved from acquisition to drilling. Every party must do their due diligence, which takes time. As for seismic data processing, it typically takes one to three months to process a medium-sized seismic program, depending on how much QC work clients require. Speed and accuracy are always our goals, but quality work cannot be rushed. The goal is to shorten the time from seismic acquisition and processing to the final interpretation deliverable.

These days AI is a hot topic. Do you foresee AI automating seismic data processing from testing the parameters for different steps in the processing sequence and getting to the final processed volume?

I first encountered discussions about AI research at the 2015 SEG conference. I can envision AI having its place in automatic seismic data processing in the future. However, I recently read an article claiming that currently the accuracy of using AI in interpretation is not very high yet. Perhaps, AI performs better in certain types of tasks than others. Given the development time, AI will improve. It can offer initial parameter selection suggestions and even processing, but experienced human interventions can never be replaced.

A side note: when both hardware and software technologies of the digital computer began to take off in the sixties, there was high hope for computer-generated music. However, up to now, a good listening non-repetitive piece of computer-generated music has yet to be heard. AI has become a hot topic lately, and whether it can do a better job in music composition remains to be

seen. Creativity and intuition are unique gifts to humans. The analogy could also apply to how much AI might assist humans in geophysical processing or interpretation.



At his office

Another question I was asked is, "if the processed seismic data volume were given to six different interpreters, will they all likely come up with six different solutions for prospects"?

Seismic processing is more an 'exact' science than seismic interpretation. Seismic processing primarily relies on mathematical calculations that produce a unique solution under the same parameters and conditions. However, the results of seismic processing projects can vary from one company to another because any typical seismic processing project involves more than a dozen stages, from data reformatting to final migration. Many parameters must be selected during this process. Seismic interpretation, on the other hand, is based on a collection of processed data, historic geological information, previous successes or failures, and the interpreter's own experience and judgement. These factors can vary significantly, which means that the interpretation of a prospect can vary greatly from one interpreter to another.

Communication is key to success in the industrial workforce! Would you agree? If so, why is it that some researchers seldom share their work at conventions or workshops?

Unlike in the university setting, publishing technological ideas in a processing company environment may not bring an immediate return. When I first started working in the industry, sharing technological ideas in conventions or publishing papers was seen as revealing a company's trade knowledge. I was fortunate that after presenting my first paper in the CSEG convention in the late 80's and gaining some international recognition through a few papers in SEG later on, the company's attitude toward publishing changed for the better. Since we learn so much from others as they share their discoveries, we have a professional duty to share our knowledge within the scientific communities to help advance technology together.

The COVID pandemic introduced the concept of working remotely, conducting online meetings, etc. Some democratized voices that have been heard have said that the old normal (office-centric culture) was not all that great. How do you view it from your personal perspective?

The in-person work mode culture during and after COVID has shifted significantly towards a remote working mode. It depends on the nature of work, as some tasks can never be suitable for remote work. The team spirit and immediate feedback interactions between coworkers in an in-person environment is irreplaceable. Perhaps, hybrid working arrangements are in order.

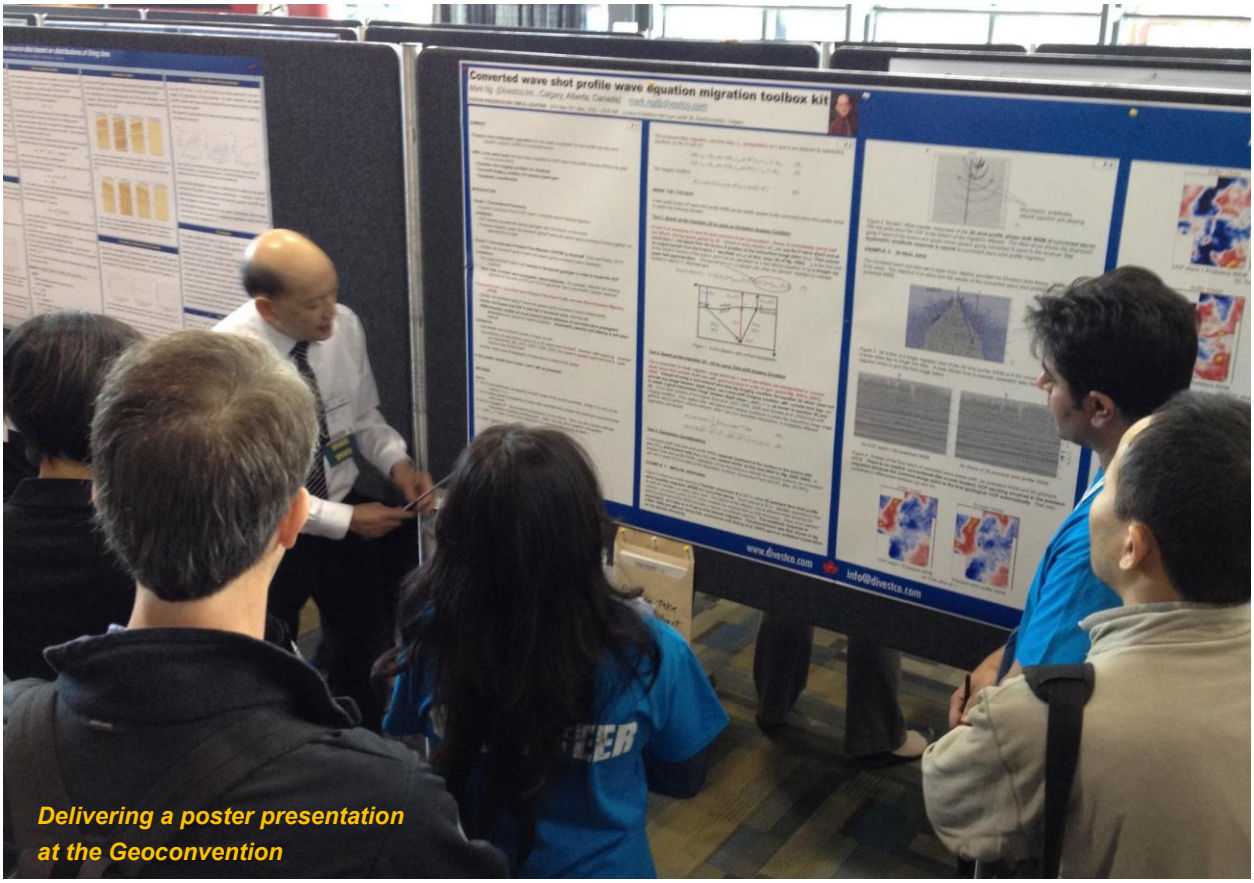
Looking back at your professional life over the past four decades, what does it take to be successful in this business?

There are three things that stay with me all the time.

Relevancy – There have been ups and downs in the seismic processing industry which is closely connected to the oil business in Canada. The industry itself is quite 'cut-throat'. To succeed, R&D efforts must be relevant and offer effective solutions to problems.

Persistency – In data fitting or inversion processes, many iterations are required to reach a minimum error point. The initial guess of the result is the first vision 'a priori' of the solution. It is also true in my research or life journey that there is a higher goal to be achieved, and it takes many error corrections to perfect it. That is persistence.

Inquisitiveness – Many scientific problems seem complex and difficult. One must observe the issue carefully to see if there is a pattern first. Then try to approach it with a simple, parsimonious method, keeping things straightforward. I always maintain a curious and learning attitude, even after being in the industry for a long time.



Delivering a poster presentation at the Geoconvention

What are some of your accomplishments that you are most proud of?

Six of my papers received SEG and CSEG recognition:

The super high-resolution Radon transform paper was ranked among the 'Top 25 Papers' out of many hundreds of papers presented in the 2004 SEG annual international meeting. The contribution of that paper is by incorporating the matching pursuit greedy method to the Gauss-Seidel algorithm in the Radon transform, it enhances the focusing capabilities and resolving power beyond that of the industry standard in multiple attenuation applications. The methodology is found to be similar to the anti-leakage Fourier transform which was presented at the same SEG conference.

Another favorite project of mine for many years is the wave equation migration (WEM). I was told that I was the first to propose 2D and 3D pre-stack phase shift shot profile migration in the early nineties, but I am not sure how accurate that is. It might be safer to say I was one of the earliest pioneers in the field because geoscientists at that time were focusing on the finite difference migration and reverse time migration which have dispersion issues, whereas the

phase shift method does not have such problems. A few years later, I integrated the time-shift imaging condition in the phase shift wave equation migration in order to efficiently extract the output images in between each depth (or time) step. This improvement increased the downward extrapolation speed of WEM by 200% to 300% while maintaining accuracy. I presented a series of papers on this subject with one paper ranking among the 'Top 30 Papers' presented at the 2007 SEG annual international meeting, and another receiving an honorable mention in the 2009 GeoConvention. Later, I also significantly improved the lateral velocity adaptation ability - a well-known challenge - of the phase shift migration through a simple trick added to the split-step mechanism of the phase shift plus interpolation method at the 2020 GeoConvention.

The 6D interpolation is another technical idea that I worked together with Dan Negut and truly enjoyed. The contribution is to safeguard and recover spatially aliased data in the interpolation process. The idea is to apply an angular weight function on the input data to get a good a priori estimate which helps to constrain the 5D MWNI interpolation. The series of publications on the 6D interpolation method has received quite a few accolades in recent years: the best oral paper at the 2016 GeoConvention and the best poster award at the 2021 GeoConvention. Additionally, we are so honored that one of the earlier 6D papers, the 2017 paper, was selected as one of 'The Greatest Hits Through Time' in the 75th Anniversary of CSEG RECORDER in the May 2025 issue.

Where do you believe our industry/profession will be in the next five years?

Due to political pressure and environmental advocates' aspirations, the oil and gas business has been forced to adapt, making a significant shift from exploration to exploitation in the past ten years. However, the demand for oil and gas has not decreased. In 2023, 81% of the world's energy was supplied by fossil fuels, 4% from nuclear energy, and the remaining approximately 15% from renewable energy (Energy Institute, 2024 Statistical review of world energy). Renewable energy sources should and will complement our heavy reliance on non-renewable sources but will not completely replace them. As a result, the industry must adjust accordingly. Recently, Canada ranked 4th in the world for known oil and gas reserves, doubling the amount found in the US. Instead of shying away from these resources due to some political pressure, we should make good use of them, as energy is power and prosperity. Canadian oil and gas are a God-given national treasure. Let us discover and use them responsibly.

You must have interacted with some famous geophysicists during your career. What are your fond memories of these interactions?

I have many respectful relationships with many well-known geoscientists. Especially during time spent at conventions, I find these geoscientists are extremely friendly, approachable and open in sharing technical ideas. To name a few geoscientists, I have learned from and interacted many times with Dave Hale, Paul Sava, Yu Zhang, Eric Verschuur, Daniel Trad, Gary Margrave and Bill Goodway.

Tell us about one thing that is most challenging about your job, and one thing that is the most enjoyable?

I do not want to trivialize the R&D work that I do. It is very challenging, and I learn something new every day. A good result from hard work is very rewarding to me. I remember few years ago, while developing the 6D interpolation, I faced three major technical challenges that seemed too difficult to solve. They occupied my mind all the time, day and night. In the end, I managed to solve all of them. Strangely, one of the solutions was given to me in a dream during the night, not from a daydream. It was a very amazing experience.

Let me ask you a philosophical question. A quote says, "Pleasure in the job puts perfection in the work". What would be your take on it?

Doing work that you enjoy is very satisfying, not to mention getting paid for it. I take great pride in the R&D work I do. I often joke with my colleagues who use my programs that there are no bugs in the processing software I wrote. If they find a bug, I will treat them to lunch. LOL! Naturally, my software programs can have bugs, but they only appear in my office domain while I am developing the program. Once the software is released, there are no bugs. It's very important to put your heart into your work. To me, work is play. So, I play it hard.

Outside of the work that that you do for a living, what other interests do you have?

I am an advanced-level pianist. I have a semi-concert grand piano at home that I enjoy playing very much. Not only do I play music, but I also write music and songs. I find music composition mentally and mathematically challenging because every measure must be balanced. Many scientists are quite musical, like Albert Einstein, who was a pianist and violinist, and Thomas Edison, who was also a pianist.

I do also enjoy photography, a hobby I have developed since my junior high school days. At one point, I used a medium format camera for many years.

I also like teaching Sunday school. Using the same teaching skills I learned there, I present all my geophysical papers. There was one time when I finished a geophysical presentation, an audience member came up to me and asked me if I do teach Sunday School.

Mark, the pianist

What would be your message for youngsters who have joined our industry recently?

In reality, the demand for oil and gas shows no sign of plateauing or declining in the foreseeable future. Renewable energy sources can and should supplement non-renewable sources, but they cannot replace them entirely. Although the geophysical industry has changed, there is always a future for it, and perhaps the competition will increase. I have a well-versed proverb for young people entering our industry: “Do not let your zeal (enthusiasm) subside; a diligent hand will prosper”.