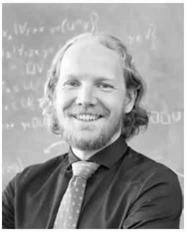

Tristan van Leeuwen

Tristan van Leeuwen obtained his MSc, in computational science at Utrecht University in the Netherlands. For his PhD, van Leeuwen switched to "Geopfysica" in Delft where he worked with Wim Mulder. He published nine papers and more than 20 abstracts during his PhD and postdoctoral fellowships at the University of British Columbia-Seismic Laboratory for Imaging and Modeling and at CWI, the Netherlands' national research institute for mathematics and computer science. van Leeuwen is now an assistant professor in the mathematics department, Utrecht University. He is the recipient of the 2015 SIAM Geosciences Junior Scientist Prize and the best student paper award for "Velocity analysis with multiples — NMO modeling for layered velocity structures."

BY FELIX J. HERRMANN

I had the good fortune to run into Tristan van Leeuwen at the tail end of my sabbatical at Delft University back in the spring of 2010. Tristan gave a talk on correlation-based inversion of seismic data. I recall vividly being very much impressed by Tristan's ability to explain technically difficult concepts in a clear and concise manner. Not long afterward, I made Tristan an offer to join my group as a postdoctoral fellow at the University of British Columbia (UBC).

Upon his arrival at UBC, Tristan embarked on a research program on wave-equation-based inversion whose impact is felt within industry and within the geophysical and mathematical communities. While at UBC, Tristan made fundamental contributions to on-the-fly source estimation during full-waveform inversion (FWI) and reverse time migration. He was the first to recognize that somewhat ad hoc practices could be seen as an instance of Golub's variable projection method. Jointly with Aleksandr (Sasha) Aravkin, another postdoctoral fellow in my group at that time, he firmly established this observation with a seminal theoretical paper that has appeared in the mathematical literature. Together with Sasha, Tristan also worked in robust inversion techniques based on data fit objectives that allow for outlying errors by choosing a misfit function derived from the student's t distribution.

Aside from these important contributions, Tristan's work on stochastic optimization and the penalty method has had by far the most impact. It goes to Tristan's credit to have convinced our community that equivalent, if not better, inversion results can be obtained by working with subsets of shots during FWI. He established this theoretically, by working with researchers in the field of optimization, as well as practically resulting in reports of four to seven times gains in computational efficiency. We received word from one of our sponsors that this innovation by itself was responsible for rendering FWI into a computationally viable service by contractor companies.

By far the most significant contribution from Tristan's hand is his work on a penalty formulation for FWI. In this formulation, the partial-differential equation (PDE) constraint is not eliminated as in the widely used adjoint-state method, but instead replaced by a weak constraint in the form of a quadratic penalty term. Tristan's main contribution in this work was to combine this formulation with variable projection. This leads to an intuitive formulation where during each iteration a wavefield is estimated that fits the data and the wave equation first, followed by an update on the model that minimizes the wave-equation misfit. This new approach to wave-equation-based inversion and imaging is reported to mitigate some of the adverse effects of cycle skipping; to be more stable for velocity models with strong velocity contrasts such as salt; and to allow for a relatively simple (via a diagonal approximation) invocation of second-order Hessian information important for inversion with constraints, multiparameter inversion, and uncertainty quantification. In addition to publications in the geophysical and inversion literature, this work resulted in the patent application, "A penalty method for PDE-constrained optimization" (US 20160070023 A1).

Finally, what really sets Tristan apart from his peers is the combination of his extraordinary work ethic, his friendly, generous, and open demeanor, and unique skill set, consisting of an extremely strong mathematical background and a profound interest, understanding, and appreciation of applied problems in geophysics and related fields. Mixing this ability with a talent to learn, apply, and above all communicate complex mathematical concepts makes him a great researcher to work with. He is a more than justified recipient of the J. Clarence Karcher Award. I am very grateful for having had the opportunity to work with Tristan, and I am looking forward to his continued innovative contributions to our community.