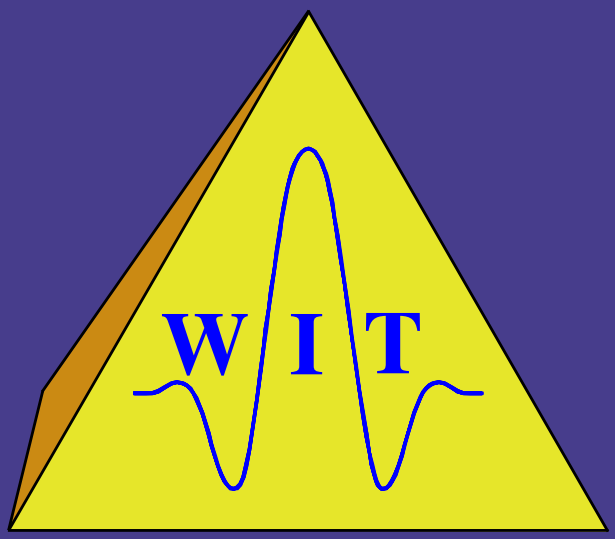
Wave Inversion Technology Consortium



Wave Inversion Technology
established 1997 in Karlsruhe, Germany

Annual Report No. 14
2010

Hamburg, 2011/14/02

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Contents

Preface

In this fourteenth issue of the annual WIT report since the foundation of the consortium, you will find nineteen papers; a substantial part of them is dedicated to CRS and related topics. However, WIT is not synonymous with CRS. Our portfolio also spans imaging, modelling, wave form inversion, and passive seismics. Like in previous years, the wide range of subjects documents recent achievements of the WIT teams in leading edge research. In addition, the year 2010 was a fruitful year for WIT in many other aspects, which we are pleased to share with you:

For the first time, a SEG meeting had a session dedicated to and including 'CRS' in the title. The 80th Annual SEG Meeting 2010 in Denver almost coincided with Peter Hubral's 70th birthday. Despite Peter's attempt to keep a low profile, the news made its way through the community. Peter even 'complained' that his friends put too much emphasis on his birthday. In a personal email, he wrote to me that *one can not force success*, but that *one has to be convinced to be on the right path. I had this kind of confidence with CRS, and now I have it with my new project: philosophy.* Obviously, Peter managed to seamlessly reach out for new challenges after his retirement from WIT and geophysics. On behalf of the whole WIT team, I thank Peter for his enthusiasm and inspiration, and we wish him good health and strength for his new projects.

Also at the 2010 SEG Meeting, the paper *A Workflow for the Processing of Reflection Seismic Data with CRS Attributes* received the best poster award. This paper summarizes the effort of a decade of research on CRS with a focus on the most recent results of pre-stack data enhancement, data regularization, and multiple suppression. Therefore, the award is a recognition of the sustained team effort from the WIT researchers. Considering how long it took to advertize the CRS method to the applied seismics community, this is a very encouraging development, which also confirms Peter's confidence in CRS.

We are especially happy to announce that a new research affiliate has entered the WIT research team: the Fraunhofer-Institut für Techno- und Wirtschaftsmathematik (ITWM) in Kaiserslautern, Germany. The ITWM specializes in developing mathematical applications for industry, technology and economy. Our new partners are the seismic imaging team of the Competence Center High Performance Computing within ITWM. This group is, among other things, well known for their 3D high resolution angle domain migration based on a generalized Radon transform. This migration and other developments in the field of seismic migration and visialization gain the computational performance from the Fraunhofer Virtual Machine concept. Some of you might have visited their booth at one of the past EAGE or SEG conferences.

Finally, we want to acknowledge your support. Without your sponsorship it would not be possible to provide so many research opportunities to students, nor to help us in our mission for leading edge research in applied seismics and as we educate the next generation of geophysicists.

Dirk Gajewski

Summary: WIT report 2010

IMAGING

Asgedom et al. propose the use of the MUltiple SIgnal Classification (MUSIC) algorithm as a replacement of semblance to obtain a high-resolution estimation of CRS parameters.

Costa et al. compare the performance of splitting techniques for stable implementations of 3D Fourier Finite-Difference (FFD) migration. Using numerical examples in homogeneous and inhomogeneous media, they show that alternate four-way splitting into the coordinate directions at one depth and the diagonal directions at the next level yields results of the same quality as full four-way splitting at the cost of two-way splitting.

Figueiredo et al. present two approaches to seismic diffraction imaging based on the diffraction operator, which can be used in both the time and depth domains, in accordance with the complexity of the area. The first method makes applies pattern recognition to the amplitudes along the diffraction operator. The second method relies on a statistical analysis of these amplitudes to design a weight function that suppresses noise and reflections and enhances diffraction events.

Garabito et al. present a new procedure of prestack depth migration combining the flexibility of the Kirchhoff migration operator with the CRS stacking method. This procedure is mainly based on CRS ability to collect paraxial amplitudes around a reference trace to be migrated over a Huygens surface and positioning the stacked values in its true depth positions.

Garabito et al. present a stable and fast poststack procedure to interactively estimate the velocity model by means of coherency and focusing analyses of diffraction events simulated from CRS-attributes. They validate this approach by using a synthetic data from a layered model.

Maciel et al. give a short introduction to automatic time migration velocity analysis methods and discuss their parametrization. Numerical examples demonstrate the how the approach works.

Perroud et al. present here the results of CRS reprocessing of a 3D real dataset. The main objective was to evaluate the ability of the methodology to recognize weak vertical-displacement faults. An original strategy was elaborated to define the best possible 3D CRS parameters. The resulting image shows improved event continuity compared to conventional processing, pointing out to a possible fault zone.

Przebindowska et al. present the application of acoustic full waveform tomography to the marine data set from the North Sea. The study discusses some of the problems that concern the field data preprocessing, wavelet estimation, and the choice of different inversion strategies.

Shahsavani and Mann present a model-based approach to the recently introdced Common-Diffraction-Surface (CDS) stack method. The latter has been specifically developed for situations where the Common-Reflection-Surface stack suffers from numerous conflicting dip situations. Originally implemented in a purely data-driven manner, the CDS approach has now also been implemented in a substantially faster model-based manner to obtain stack sections optimized for poststack migration. This approach is well

suited for complex data where prestack migration is unapplicable due to difficulties in building a macro-velocity model of sufficient accuracy.

Zhebel et al. present an extension of the localization of seismic events by diffraction stacking to 3D media. Examples for data with a high noise level in homogeneous media are considered as well as heterogeneous media with triplications. Also effects of the double couple radiation pattern were investigated. Furthermore, a field data example from Southern California is presented where the acquisition footprint is compensated by weights based on Voronoj cells.

MODELING

Dell and Gajewski propose a new method for tomographic inversion. The inversion is based on the kinematic wavefield attributes extracted in the time-migrated domain. The method can be seen as an additional tool to provide constraints for kinematic velocity model building. It is particularly useful in areas where diffractions and triplications are located close to reflections generating conflicting dip situations. The method has been successfully tested on a synthetic data example.

Dell and Gajewski present an application of the CRS-based diffraction imaging to synthetic and field data. They also show how the separated diffracted events can be used to build time-migration velocity model.

Kaschwich et al. investigate the impact of diffractions on pre-stack depth migration images and discuss some correlated resolution aspects. Furthermore, we present examples where we apply a ray-based approach to compute synthetic seismograms for both reflected and diffracted events. Finally, we document the applicability of the approach to different model types, e.g. isotropic and anisotropic media.

Tessmer demonstrates that the Rapid Expansion Method (REM) for seismic modelling applied in a time-stepping manner is superior to finite-difference time-stepping. This is important for long propagation times where numerical dispersion might occur. He tests the solutions of REM by comparison with analytic solutions. He also shows how the time derivative of the solution of the wave equation needed, e.g., for the computation of Poynting vectors can be calculated at almost no extra cost.

OTHER TOPICS

Baykulov et al. describe the use of CRS attributes in various modules for reflection seismic data processing. The CRS attribute based modules contribute to multiple suppression, model building, pre-stack data enhancement and depth imaging. The paper demonstrate the interaction of the modules and shows the benefits by combining them in a processing workflow. For example, the prestack data enahncement not only improves the quality of prestack data but also helps to suppress filtering artifacts in multiple removal and allows a better QC of migration velocities.

Dramsch and Gajewski deleted traces from a synthetic data record to interpolate over sparse data and to extrapolate over the end of acquisition. They compare the original traces to the results of the interpolation process using partial CRS stacks. The results are encouraging not just for short offsets but also for intermediate offsets and at the end of the acquisition. This observation concerns arrival times and frequency content of the interpolated traces.

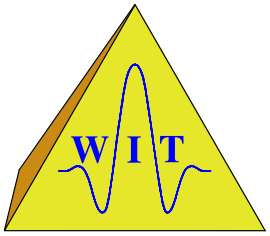
Santos et al. apply the fast extraction of CRS parameters using modern local-slope-extraction techniques to synthetic data from inhomogeneous velocity models. A comparison of the numerical results to a simplified implementation of a conventional CRS procedure demonstrates that the technique lead to meaningful values for the so-determined CRS parameters.

Tygel et al. extend previous expressions for inversion of reflector dip and curvature from CRS coefficients of time-migrated reflections to include (a) A simpler and more direct expression for the reflector curvature and (b) Corresponding expressions for the CRS coefficients for ZO (stacked) reflections. The

obtained expressions represent useful constraints for map migration along normal rays or image rays.

Vanelle et al. suggest a new stacking operator for curved subsurface structures. The resulting implicit traveltime expression is derived from evaluating Snell's law at a locally spherical interface. Examples show that the new operator performs well for a wide range of reflector curvatures from nearly planar reflectors to the diffraction limit.

The Wave Inversion Technology (WIT) Consortium



The Wave Inversion Technology Consortium (WIT) was established in 1997 and is organized by the Institute of Geophysics of the University of Hamburg. It consists of three integrated working groups, one at the University of Hamburg and two at other universities, being the Mathematical Geophysics Group at Campinas University (UNICAMP), Brazil, and the Geophysical Institute of the Karlsruhe University. In 2003, members of the Geophysical Department at the Federal University of Pará, Belém, Brazil, have joined WIT as an affiliate working group. In 2007, NORSAR joined WIT as research affiliate. The WIT Consortium offers the following services to its sponsors:

a.) research as described in the topic "Research aims" below;

b.) deliverables;

c.) technology transfer and training.

RESEARCH AIMS

The ultimate goal of the WIT Consortium is a most accurate and efficient target-oriented seismic modelling, imaging, and inversion using elastic and acoustic methods. Within this scientific context it is our aim to educate the next generations of exploration geophysicists.

Exploration and reservoir seismics aims at the delineation of geological structures that constrain and confine reservoirs. It involves true-amplitude imaging and the extrapolation of the coarse structural features of logs into space. The goals on seismic resolution are constantly increasing which requires a complementary use of kinematic and wave equation based techniques in the processing work flow. At WIT we use a cascaded system of kinematic and full wave form model building and imaging techniques. Since our data and inversions are never perfect it is the challenge to find those techniques which produce the best images for erroneous velocities and faulty wave forms.

The WIT consortium has the following main research directions, which aim at characterizing structural and stratigraphic subsurface characteristics:

- Imaging and inversion in 2, 2.5, and 3D
- AVO and inversion
- Macrovelocity model building and updating
- Local event slopes
- CRS real data processing
- CRS and multiparameter processing topics

- Imaging of acoustic emissions (passive seismics)
- True-amplitude migration
- Seismic interferometry
- Full waveform tomography
- Forward modelling
- Migration and tomography

WIT PUBLIC RELATIONS COMMITTEE

Name	University	Area
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Claudia Vanelle	Hamburg	Administration and contact to representatives, WIT Report

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Bertrand Duquet	Total E&P RD
Henning Trappe	TEEC

COMPUTING FACILITIES

The Hamburg group has access to a 264 nodes (16 dual core CPUs, 8448 cores in total) IBM p575 "Power6" cluster at the German Computer Center for Climate Research (Deutsches Klimarechenzentrum, DKRZ) for numerically intensive calculations. It is equipped with 20 TeraByte of memory and its performance per core is 18.8 GigaFlops. There is also access to a SUN Linux cluster with 256 nodes (2 quad core Opteron, 32 GB each). A SUN Fire X4600 (8 dual core Opteron, 32 GB) is exclusively available for the group's computing demands. Additional computer facilities consist of several Linux workstations and Linux PCs.

The research activities of the Campinas Group are carried out in the Computational Geophysics Laboratory. The Lab has many PC Linux workstations and Sun Ultra 60/80 workstations connected by a dedicated network, suitable for parallel processing. Educational grants provide seismic packages from leading companies such as Landmark and Paradigm. Besides State Government funds, substantial support both for equipment and also scholarships are provided by the Brazilian Oil Company Petrobras. An extension of the Lab with substantial increase of computer power and space is being built in the new facilities of the Center of Petroleum Studies. The new Lab, expected to be in operation next year, will also have remote access to the computing facilities of the Petrobras Research Center in Rio de Janeiro.

The local facilities of the WIT group in Karlsruhe mainly consist in about 20 clustered quad-core Linux workstations. For large-scale computational tasks, a Hewlett-Packard XC3000 Linux cluster is available on campus. It hosts about 300 nodes with two quad cores each. The total nominal peaker power is 27 TFlops, the total main mmemory 10 TByte. About 300 TByte disk space are availble via a Lustre file system and an InfiniBand interconnect. In addition, we have access to the computing facilities of the state-owned bwGRiD consisting of a total of 101 IBM blades centers distributed over seven universities in Baden-Württemberg.

The main computing facility at the Geophysics Graduation Program in Belém is the Seismic Processing Lab (ProSis). The hardware resources include: workstations (RS3600) from IBM and a SUN SparkStation 20, all networked to a local server SUN Enterprise-3500 with 2 processors; several networked Linux-PCs; for large-scale applications, a cluster of PCs with 20 dual-processor nodes. The proprietary software packages available for seismic applications are ProMAX, Disco-Focus, and Gocad.

WIT research personnel

Khawar Ashfaq Ahmed received a B.Sc. from the University of the Punjab in Lahore, Pakistan, in 2005. He received a M.Sc. in Geophysics in 2007 and a M.Phil. in Geophysics in 2009, both from the Quaid-i-Azam University in Islamabad, Pakistan, where he also worked for three years as teaching and research associate in the Department of Earth Sciences. Since 2010, he is enrolled at the University of Hamburg as a Ph.D. student in Geophysics. His current research interests are 3D seismic imaging, CRS stacking, and NIP wave tomography.

Rafael Aleixo received a B.Sc. (2003) in Mathematics and an M.Sc. (2007) in Applied Mathematics from University of Campinas (UNICAMP), Brazil. Since 2007 he has been a Ph.D. student at UNICAMP. His research interests include seismic imaging methods, seismic modeling, anisotropy, and image-wave propagation. He is a member of SEG, EAGE, SBGf, and SBMAC.

Daniela Amazonas graduated in Mathematics (2004) and received her M.Sc. in Geophysics (2007), both from Federal University of Pará (UFPa), Belém, Brazil, where she is working toward a Ph.D. in seismic methods. Her research interests are concentrated in wave-equation migration methods. She is a member of SEG and SBGf.

Denis Anikiev is studying for a bachelor degree at the Department of Physics of Earth at St.Petersburg State University, Russia. He participated in an exchange program with Hamburg University in 2006,2007 during his work on the "Localization of Seismic Events by Diffraction Stacking". His present research interests include localization of seismic events, inverse problems for acoustic media, and virtual source technology. He is a student member of SEG, EAGE, SPE.

Mikhail Baykulov received his diploma in geophysics in 2004 from Saratov State University, Russia. He confirmed his diploma in 2005 at the University of Hamburg with a thesis on the application of the CRS stack to reflection data from the crystalline crust of Northern Germany. In April 2009, Mikhail defended his PhD thesis with the title Seismic imaging in complex media with the Common Reflection Surface stack. His present research interests include 2D/3D CRS imaging, velocity model building, and depth inversion of seismic data.

Mehrnoosh Behzadi has received her M.Sc. in seismology from Islamic Azad University of Iran in 2009. Since 2011, she is a Ph.D. student in the Hamburg WIT group. Her research interests include passive seismics, site effects, and exploration seismology.

Ricardo Biloti received his B.Sc.(1995), M.Sc. (1998) as well as Ph.D. (2001) in Applied Mathematics from the State University of Campinas (UNICAMP), Brazil. He worked at Federal University of Paraná (UFPR), Brazil, as an Adjoint Professor, at the Department of Mathematics, from May 2002 to September 2005, when he joined Unicamp as an Assistant Professor. He has been a collaborator of the Campinas Group since his Ph.D. His research areas are multiparametric imaging methods, like CRS for instance. He has been working on estimating kinematic traveltime attributes and on inverting them to construct velocity models. He is also interested in Numerical Analysis, Numerical Linear Algebra, and Fractals. He is a member of SBMAC (Brazilian Society of Applied Mathematics), SIAM and SEG.

Thomas Bohlen received a Diploma of Geophysics (1994) and a Ph.D. (1998) from the University of Kiel, Germany. From 2006 to 2009 he has been Professor of Geophysics at the Institute of Geophysics at the Technical University Freiberg where he has been the head of the seismics and seismology working groups. Since 2009, he is Professor of Geophyics at the Geophysical Institute of the Karlsruhe Institute of Technology. He is the head of the applied geophysics group. His research interests and experience include: seismic modelling, full waveform inversion, surface wave inversion and tomography, reflection seismic imaging. He is a member of SEG, EAGE, AGU, ASA, and DGG (member of the executive board).

Pedro Chira Oliva, received his diploma in Geological Engineering (UNI-Peru/1996). He received his MSc., in 1997 and PhD., in 2003, both in Geophysics, from Federal University of Pará (UFPA/Brazil). He took part of the scientific research project "3D Zero-Offset Common-Reflection-Surface (CRS) stacking" (2000-2002) sponsored by Oil Company ENI (AGIP Division - Italy) and the University of Karlsruhe (Germany). Currently he is full Professor at the Institute of Coastal Studies (IECOS) of UFPA. His research interests include seismic stacking and seismic modeling. He is member of GOCAD consortium (France) and SBGf.

Jessé Carvalho Costa received his diploma in Physics in 1983 from the Physics Department, Federal University of Pará (UFPA) and a Doctor degree in Geophysics in 1993 from the Geophysics Department at the same University. He was a Summer Student at Schlumberger Cambridge Research in 1991 and 1992. He spent 1994 and 1995 as a post-doc in the Stanford Tomography Project at Stanford University. He held a faculty position the Physics Department at UFPA from 1989 to 2003. Currently he is Associate Professor in the Geophysics Department, UFPA. His fields of interest include seismic anisotropy, traveltime tomography and seismic modeling.

Joõ Carlos Ribeiro Cruz received a BSc (1986) in geology, a MSc (1989), and a PhD (1994) in geophysics from the Federal University of Pará (UFPA), Brazil. From 1991 to 1993 he was with the reflection seismic research group of the University of Karlsruhe, Germany, while developing his PhD thesis. Since 1996 he has been full professor at the geophysical department of the UFPA. His current research interests include velocity estimation, seismic imaging, and application of inverse theory to seismic problems.

Sergius Dell received a diploma in Physics from the University of Yekaterinburg (Russia) in 1997. He received his diploma in Geophysics in 2009 from the University of Hamburg. Since 2009 he has been a Ph.D. student at the University of Hamburg. His present research interests include CSP data mapping and time migration velocity analysis on CSP gathers, CRS imaging of the time-migrated reflections and velocity model building by Image Incident Point Tomography, extraction of diffraction events using the CRS stack and poststack time migration velocity analysis.

Jesper Sören Dramsch participated in the junior studies programme at the University of Hamburg in 2006. He continued his studies in Geophysics at the same university and finished his BSc thesis in 2010. Recently he is participating in the postgraduate programme in Geophysics at the University of Hamburg. He is currently working on partial CRS stacks and trace interpolation.

Stefan Dümmong received his diploma in Geophysics in 2006 from the University of Hamburg. Since 2006 he was PhD student in the Institute of Geophysics at the University of Hamburg. He defended his PhD thesis in 2010. His research interests are imaging procedures and multiple removal techniques. He is a member of EAGE.

Simone Dunkl received a Diploma in Geophsyics in July 2010 from the KIT with a thesis on the modeling of basin effects in the Taipei basin. Since September 2010, she is a PhD candidate in the TOAST project working on elastic 3D full waveform inversion.

Dirk Gajewski received a diploma in geophysics in 1981 from Clausthal Technical University and a PhD from Karlsruhe University in 1987. Since 1993, he has been associate Professor (Applied Geophysics) at Hamburg University. After his PhD, he spent two years at Stanford University and at the Center for

Computational Seismology at the Lawrence Berkeley Lab in Berkeley, California. From 1990 until 1992, he worked as an assistant professor at Clausthal Technical University. His research interests include high-frequency assymptotics, seismic modeling, and processing of seismic data from isotropic and anisotropic media. Together with Ivan Psencîk, he developed the ANRAY program package. He is a member of AGU, DGG, EAGE, and SEG, and served as an Associate Editor for Geophysical Prospecting (section anisotropy) from 1997 to 2002.

German Garabito received his BSc (1986) in Geology from University Tomás Frias (UTF), Bolivia, his MSc in 1997 and PhD in 2001 both in Geophysics from the Federal University of Pará (UFPA), Brazil. Since 2002 he has been full professor at the geophysical department of UFPA. His research interests are data-driven seismic imaging methods such as the Common-Refection-Surface (CRS) method and velocity model inversion. He is a member of SEG, EAGE and SBGF.

Tobias Geib has been a diploma student at the KIT in Karlsruhe. He is a member of the Applied Geophysics group since November 2009. He works on the calibration of our superconductive gravimeter located in the Black Forest Observatory and received a Diploma in Geophysics in December 2010. He is a member of DGG.

Håvar Gjøystdal is Research Manager of Seismic Modelling at NORSAR in Kjeller, near Oslo. He also holds an adjunct position of Professor of Geophysics at the Department of Earth Science, University of Bergen. In 1977 he joined NORSAR and started building up research activities within the field of seismic modelling, which to-day include both R&D projects and services and software products for the petroleum industry. Key topics are ray tracing, seismic tomography, and time lapse seismic modelling. He is a member of SEG and OSEG.

Anderson B. Gomes obtained his Bachelor Degree in Mathematics in 2004, and his Masters Degree in Geophysics in 2006, both in the University of Pará (UFPA), Brazil. Presently, he is a doctor student in the Graduate Course in Geophysics of UFPA in the area of seismic methods applied to oil and gas exploration. He is member of SEG and of SBGF.

Ellen de Nazaré Souza Gomes received her diploma in Mathematics in 1990 from University of Amazônia. She received her Master degree in Applied Mathematics in 1999 from the Mathematics Departament, Federal University of Pará. In 2003, she received her Doctor degree in Geophysics from Geophysics Department at the same University. Her fields of interest are anisotropy and seismic modeling. She has been professor at the Federal University of Pará since 1997.

Sven Heider is a member of the Applied Geophysics group at the KIT since November 2009. In December 2010, he received a Diploma in Geophysics with a thesis on the interpretation of impact noise measurements. He continues his studies as a PhD student in the SOUND project working on the application of near-surface imaging methods on tunnel seismic data. He is a member of DGG.

Olaf Hellwig studied geophysics at TU Bergakademie Freiberg, Germany. Between 2004 and 2005 he spent one year at NTNU Trondheim, Norway. He received his diploma in geophysics in 2007. Since 2008 he is Ph.D. student in the Institute of Geophysics at TU Bergakademie Freiberg. His research interests focus on modeling of seismic wave propagation in boreholes and imaging of reflectors ahead of the drill.

Einar Iversen received Cand.scient. (1984) and Dr. philos. (2002) degrees in geophysics, both from the University of Oslo, Norway. He has worked for NORSAR since 1984 and is currently a senior research geophysicist within NORSAR's Seismic Modeling Research Programme. He received the Best Paper Award in Geophysical Prospecting in 1996. His professional interests are seismic ray theory and its application to modeling, imaging, and parameter estimation. He is a member of SEG and EAGE.

Stefan Jetschny received a Bachelor in Geophysics in 2003 at the TU Bergakademie Freiberg. After finishing internships at RWE Dea, Hamburg, Baker Hughes Inteq, Celle and Eastern Atlas, Berlin, he con-

tinued his studies in 2004 at the Institute of Geophysics, TU Bergakademie Freiberg. In 2005 he wrote his Diploma thesis at Baker Hughes Inteq in Houston, USA and received a Diploma (Master) in Geophysics in 2006 at the TU Bergakademie Freiberg. In 2010 he received a Doctorate in Natural Sciences from the Karlsruhe Institute of Technology with a thesis on tunnel surface-waves. His research interests focus on LWD and wireline imaging tools, processing of borehole imaging data, 2D/3D seismic modelling of full elastic wavefields and the propagation of tunnel surface-waves. He is a member of DGG, SEG, AGU, and EAGE.

Shin Duck Kang received a Bachelor degree in Applied Mathematics in 1994 in South Korea. He has studied the symbolic program analysis for a cross section of two Fermion particle scattering until 2005 in a Ph.D course on particle physics at the University of Konkuk, South Korea. He received his M.Sc. degree (2008) in Computational Science from the Dept. of Physics, J.W. Goethe University Frankfurt am Main, Germany. After graduating Computational science, he has joined the WIT group at the Karlsruhe Institute of Technology (KIT). His current interest is the implementation and application of 3D NIP tomography based on CRS-Stack attributes and a B-spline velocity model. He is a member of EAGE and SEG.

Tina Kaschwich received her diploma in geophysics (2001) and a Ph.D. in geophysics (2006), both from the University of Hamburg. Since 2005 she has been a research fellow at the seismic modelling group at NORSAR, Norway. Her research interests are ray tracing and wavefront construction methods, imaging and illumination studies for survey planning and quality control for different model and wave types. She is a member of EAGE, OSEG and SEG.

Boris Kashtan obtained his MSc in theoretical physics from Lenigrad State University, USSR, in 1977. A PhD (1981) and a Habilitation (1989) were granted to Boris by the same University. He is Professor at St. Petersburg State University, Russia, and since 1996 Boris is head of the Laboratory for the Dynamics of Elastic Media. His research interests are in high frequency methods, seismic modeling, inversion, anisotropy, and imaging. He regularily visits Germany and spends from weeks to several month at the University of Hamburg every year.

Daniel Köhn received his diploma in geophysics from Kiel University in 2005 with a thesis on modeling of elastic waves by finite differences on a spatially variable grid. From 2005 to 2006 he has been a PhD student at the Institute of Geophysics at Kiel University, where he has been involved in the "Scherseis 3D" project funded by the German Research Society (DFG). Since 2007 he is a research associate at the Technische Universität Bergakademie Freiberg. His research interests are Time-Domain-Full-Waveform-Inversion and numerical modeling of seismic wave propagation.

André Kurzmann studied geophysics at the TU Bergakademie Freiberg. In 2006 he received his diploma in geophysics. From 2006 to 2007 he worked in several engineering offices. His tasks were supervision, performance and analysis of geophysical measurements. Since 2007 he is a Ph.D. student at the Institute of Geophysics, TU Bergakademie Freiberg (2007–2009) and at the Geophysical Institute, Karlsruhe Institute of Technology (since 2009). His research interests focus on 2D seismic modelling of acoustic/elastic wavefields and 2D full waveform inversion applied to reflection and crosshole acquisition geometries. He is a member of AGU and IAMG.

Isabelle Lecomte received an M.S. (1987) in geophysics, an Engineering Geophysics (1988) degree, and a Ph.D. (1991) in geophysics, all from the University of Strasbourg, France. In 1988-1990, she worked as a Ph.D. fellow at IFREMER/University of Strasbourg. In 1991-1992, she was a post-doctoral fellowship at NORSAR, Norway (grant from EU in 1991, and the Research Council of Norway in 1992). Since 1993, she joined NORSAR permanently as a senior research geophysicist in R&D seismic modelling, and is now a principal research geophysicist. Since 2003, she is also a part-time researcher at the International Centre for Geohazards (ICG, Oslo), acting as the theme coordinator for geophysics. She received the EAGE Eötvös award (best paper, Geophysical Prospecting) in 2001. Her main research interests are seismic modelling (finite-differences, ray-tracing, Eikonal solvers, hybrid RT-FD), with applications to seismic reflection, refraction and tomography in oil exploration, and seismic imaging (generalized diffraction tomography)

including resolution studies. More recent studies concerned seismic imaging with SAR-type processing, and simulation of PSDM images. She is a member of EAGE, OSEG, and SEG.

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