Wave Inversion Technology Consortium

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Preface

On behalf of the members of the Wave Inversion Technology (WIT) Consortium—in the different groups in Belém, Berlin, Campinas, Hamburg and Karlsruhe—I want to thank the WIT sponsors for their continued support. I am pleased to see that the WIT activities continue to be as strong as in the previous years. There we have seen more and more of our scientific research efforts go into the development of new theories, implementations of algorithms and workflows for seismic imaging, tomographic inversion, characterization of rock properties and passive monitoring. Anisotropy remains a major topic.

The past year—the 9th year of the WIT Consortium—distinguishes itself from the previous years by the fact that the collaboration with various sponsors was stronger than ever before. Some sponsors are very enthusiastic about our activity, others keep only an eye on what we are doing. In any case many sponsors have provided us with real seismic data and their experience in processing seismic data with our algorithms in industrial environments. They have accepted PhD students to stay within their companies. This has helped us to adjust our activities and the development of our methods more to the needs of the WIT sponsors. One sponsor representative from Landmark has even spent two months in Karlsruhe.

In spite (or maybe because) of the present boom in the Oil Industry, Geophysical famous Research Consortia in the USA seem to get less popular. The Industry appears to desire more and more a particular cooperation with Universities rather than supporting general Consortia research. I am concerned that the WIT Consortium may be affected by this trend. Therefore I want to stress the advantages of WIT compared to other International Consortia.

In spite of the tightening financial support that German Universities get from the government, WIT research is still indirectly (in form of salaries and infrastructure) strongly supported by the government as are the Brazilian WIT partners. For that matter WIT can provide an extremely cost-effective service to the industry compared to other international consortia that have to charge their sponsors 2-3 more than we require.

But it is not because of being cheap that we want to keep our sponsors satisfied. We want to maintain the high standard of innovation of the past. For this the present working conditions in WIT are optimal even though Geoscience Institutes in German Universities are nowadays suffering from lack of government support. Some institutions have even been closed. On the other hand exists presently a tremendous international demand for well-trained geophysics students that cannot be met.

WIT members look forward to reinforce the close cooperation from which WIT sponsors should benefit. I am looking forward to give my position over to my successor in 2006. The transition is not as straightforward as I expected, but I see no reason for concern. I hope that in this time of change our WIT supporters will maintain confidence in our future research activities. We look forward to continue our extensive exchange of ideas for years to come with sponsor representatives.

Peter Hubral

Summary: WIT report 2005

IMAGING

Camargo and Santos present an efficient algorithm for the uniform resampling problem, using Shannon Sampling Theorem (Sinc function) and the aproximation of the pseudo-inverse of a matrix. To illustrate the approach, we apply the algorithm to resample a seismogram and to recover a corrupted two-dimensional image.

Cruz et al. identify first-order interbed symmetric multiple reflections. For this, they compare parameters of hypothetical NIP and N wavefronts obtained by forward modeling and Kirchhoff migration. This comparison is verified also with the NMO velocity.

Müller presents a technique for correcting traveltimes and wavefield attributes obtained by means of coherence analyses. Search aperture dependent “best fit” quantities are extrapolated to zero-aperture in order to obtain the desired attributes as well as a corrected stack section.

Spinner presents an CRS-based approach for minimum aperture Kirchhoff migration in the time domain. The main focus of the method lies on the migration amplitudes and the resulting improvments in AVO/AVA analysis.

Klüver presents a new technique for migration based velocity model update. It is based on the same model parameterization as CRS-based tomography but partially overcomes the limitation to second order of that method.

Novais et al. present a stable implementation of image-wave remigration in the time domain, demonstrating the computational efficiency of the algorithm. An example using ground-penetrating-radar (GPR) data demonstrates how image-wave remigration can be used to estimate a model of the medium velocity.

Schleicher and Aleixo derive image-wave equations, that is partial differential equations that describe the dislocation of a reflector image as a function of the velocity model, for time and depth remigration in elliptically anisotropic media, under variation of migration velocity and medium ellipticity. A numerical example demonstrates the validity of the theory.

Kashtan, Tessmer and Gajewski show that the commonly used acoustic 2D one-way wave equation needs to be modified in order to yield correct amplitudes. In order to yield correct results amplitudes from the one-way and the two-way wave equations need to be the same in the direction into which energy is propagated. They theoretically explain artifacts when using the one-way wave equation.

Buske et al. describe an extension of Kirchhoff prestack depth migration. The so-called Fresnel-Volume-Migration restricts the migration operator to the physically relevant part of the subsurface using the concept of Fresnel-Volumes and the emergence angle determined at the receiver from a local slowness analysis. The application to a synthetic model as well as to a real data set over a salt pillow demonstrates the benefits of this method, e.g. enhanced image quality and resolution.

Ferreira and Cruz extend that KGB-PSDM algorithm to the case of a depth-dependent velocity medium. A sensibility analysis is made in order to test for possible errors in velocity models.

Santos and Tygel propose an algorithm to invert elastic-parameter contrasts from Amplitude-versus-Ray Parameter curves using the reflection impedance approximation of the PP-reflection coefficient. First results shown on synthetic data indicate that the procedure may offer a promising alternative to existing methods of inverting reservoir attributes from AVO/AVA curves

Kashtan, Gajewski, Tessmer, and Vanelle explain and verify by numerical studies that the localization of seismic events by reverse modeling or other back-projection methods possess inherent errors. The location and timing of the events by these methods are systematically shifted toward the receiver network and to earlier hypocentral times. The errors depend on the acquisition geometry and the length of the recorded signal.

Yoon et al. applied the CRS stack method to crustal reflection data from the North German basin which were recently released by the industry. The data were acquired and processed in the early 80ies with the focus on the sedimentary fill of the basins. The focus of the reprocessing was moved to imaging of the deeper structures within the basin. The new results yielded improved images of structures in the lower and middle crust. Also, the visibility of the Moho was significantly enhanced. This example shows a first succesful application of the CRS stack method to real crustal reflection data.

Heilmann et al. are giving attention to the seismic processing and interpretation of a land data set from the Takutu basin, Brazil. The presented extension of CRS-stack-based time-to-depth imaging supports arbitrary top-surface topography and is well suited to the specific problems of land data processing, namely, sparse data, complex geological structures, and complicated near surface conditions. The following processing steps were carried out: CRS stack, residual static correction, determination of a macrovelocity model via tomographic inversion, and Kirchhoff pre- and poststack depth migration.

ROCK PHYSICS AND WAVES IN RANDOM MEDIA

Gerner et al. investigate P-wave attenuation in vertical direction caused by interlayer flow and scattering in poroelastic media. Numerical and analytical results indicate that interlayer flow may be a significant attenuation mechanism in highly permeable sediments. Especially in the lower seismic frequency range poroelastic modeling yields attenuation values that are comparable to field observations.

Zanoth et al. consider the leaky mode, a possible attenuation phenomenon of seismic waves in a gas-hydrate-bearing sediment layer. This attenuation mechanism in horizontal direction occurs when a high-velocity layer is embedded in a low velocity zone. This is a typical situation for gas hydrate occurrences. We will demonstrate that the leaky mode is a significant attenuation mechanism which cannot be neglected.

Ciz et al. perform numerical simulations using the rotated staggered grid for an idealized porous medium, namely a periodic system of alternating solid and viscous fluid layers. The simulation results show excellent agreement with the theoretical predictions. Specifically the simulations agree with the prediction of Biot's theory of poroelasticity at lower viscosities and with the viscoelastic dissipation at higher viscosities.

Saenger et al. consider viscous fluid effects on wave propagation. They implement an accurate approximation of a Newtonian fluid into a finite-difference approach. Biot-type effects can be observed in numerical experiments on a micro-scale, i.e from first principles.

Saenger et al. model a Biot slow wave on microscale. Since the theory of dynamic poroelasticity was developed by Biot (1956), the existence of the type II or Biot's slow compressional wave (SCW) remains the most controversial of its predictions. To our knowledge this is the first time that the slow wave is simulated on first principles.

Davolio et al. make a review of impedance-type approximations for the P–P reflection coefficient and introduce the corresponding approximation for the P–S reflection coefficient. They also describe how to estimate the ratios of some elastic parameters, directly from the data, using the concept of the impedance function. Some illustrative examples for a well-log data are presented.

Müller analyzes effective properties of diffusion waves in randomly inhomogeneous poroelastic solids.

Brajanovski et al. analyze characteristic frequencies of seismic wave attenuation due to wave-induced flow in fractured porous rocks.

MODELING

Bohlen and Saenger consider the accuracy of different finite-difference approaches for modeling Rayleigh waves. The conventional standard staggered-grid (SSG) and the rotated staggered grid (RSG) is investigated. For an irregular interface the RSG scheme is more accurate than the SSG scheme. The RSG scheme, however, requires 60 grid points per minimum wavelength to achieve good accuracy for all dip angles.

Silva Neto et al. describe a velocity-stress formulation for elastic finite-difference modeling of elastic wavefields in 2.5 dimensions. The approach is appealing due reduced storage and computing time when compared to full 3D finite difference elastic modeling. Numerical experiments show the accuracy of the scheme.

Lima et al. give a theoretical revision about 3-D CRS Stack. They make a comparison of the CRS traveltime approximation for reflection and diffraction events with respect to true traveltimes. Although the 3-D ZO CRS operator have a better fit then the 3-D ZO CDS operator, the last also can be used for 3-D Stacking.

OTHER TOPICS

Schleicher and Biloti discuss a frequency criterion on how to choose the number of nodes for a smoothing by optimal cubic splines. They also compare smoothing results to those obtained by filtering using a moving average and a lowpass.

Tygel and Ursin examine the power series representation of traveltime as a function of offset for multiply transmitted and reflected wave in VTI media. They show that there is convergence for sufficiently small offsets, except in the case of a vanishing NMO-velocity. This can happen for qSV propagation in some layer. The situation of on-axis triplication, which occurs when the squared NMO-velocity becomes negative is also discussed.

Vanelle and Gajewski suggest a method to determine the vertical slowness in a weakly anisotropic medium, if only the horizontal slowness components are known. The main applications for the method are the reflection-transmission problem between two anisotropic media, and the traveltime-based determination of geometrical spreading and true-amplitude migration weight functions for anisotropic media.

Netzeband, Hübscher, and Gajewski have shown that in the initial stages of salt movement in the Levantine Basin very little lateral evaporite movement has taken place in the past 5 Ma, the direction of this movement is controlled by the sediment load of the Nile River. Five sub-units of evaporite deposition have been found, which have been deformed syn-depositionally.

The Wave Inversion Technology (WIT) Consortium

The Wave Inversion Technology (WIT) Consortium was established in 1997 and is organized by the Geophysical Institute, Karlsruhe University, Germany. It consists of four fully integrated working groups, one at Karlsruhe University and three at other universities, being the Mathematical Geophysics Group at Campinas University (UNICAMP), Brazil, the Seismics / Seismology Group at the Free University (FU) in Berlin, Germany, and the Applied Geophysics Group (AGG) of the Hamburg University, Germany. In 2003, the Geoscience Center at the University of Pará, Belém, Brazil joined the WIT Consortium as an affiliated working group. 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 modeling, imaging, and inversion using elastic and acustic methods. Traditionally, 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 onto space. Today, an understanding is emerging on how sub-wavelength features such as small-scale disorder, porosity, permeability, fluid saturation, etc. influence elastic wave propagation and how these properties can be recovered in the sense of true-amplitude imaging, inversion, and effective media. The WIT Consortium has the following main research directions which aim at characterizing structural and stratigraphic subsurface characteristics and extrapolating fine grained properties of targets:

1. data-driven multicoverage zero-offset and finite-offset simulations
2. macromodel determination
3. seismic image and configuration transformations (data mapping)
4. true-amplitude imaging, migration, and inversion
5. seismic and acoustic methods in porous media
6. passive monitoring of fluid injection
7. fast and accurate seismic forward modeling
8. modeling and imaging in anisotropic media

WIT PUBLIC RELATIONS COMMITTEE

Name	University	Area
Peter Hubral	Karlsruhe	WIT headquarters
Claudia Payne	Karlsruhe	WIT headquarters
Jürgen Mann	Karlsruhe	WIT headquarters & WIT report
Alexander Müller	Karlsruhe	WIT report & WIT CD-R
Nicolas Hummel	Karlsruhe	WIT report
Markus von Steht	Karlsruhe	WIT homepage manager

STEERING COMMITTEES

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Martin Tygel	Campinas	Thomas Hertweck	Fugro Robertson
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Claudia Payne	Karlsruhe	Leon Hu	Saudi Aramco
Jörg Schleicher	Campinas	Pierre-Alain Delaittre	Total
Sergei Shapiro	Berlin	Henning Trappe	TEEC
Ekkehart Tessmer	Hamburg	Alfonso Gonzalez	WesternGeco

COMPUTING FACILITIES

In Karlsruhe, the research project uses computer facilities that consist of mainly Hewlett-Packard (HP), Silicon Graphics (SGI), and Linux workstations. These are networked with a local compute server, a SGI Origin 3200 (6 processors, 4GB shared memory). For large-scale computational tasks, an IBM RS/6000 SP-SMP (256 nodes + 52 nodes) and a Fujitsu VPP 5000 are available on campus. If there is still a request for more computing power, a Cray T3e (512 nodes), a NEC SX-4/32, and a Hitachi SR8000 (16 nodes) can be used via ATM networks at the nearby German National Supercomputing Center (HLRS) in Stuttgart.

The Hamburg group has access to a 16 nodes (8 CPUs and 8 GB each) NEC SX-6 supercomputer at the German Computer Center for Climate Research (Deutsches Klimarechenzentrum, DKRZ) for numerically intensive calculations. Additional computer facilities consist of several SUN workstations and Linux PCs.

The Geophysical Department of the Free University of Berlin has excellent computer facilities based on Sun- and DEC-Alpha workstations and Linux PCs. Moreover, there exists access to the parallel supercomputer Cray T3m (256 proc.) of ZIB, Berlin.

The research activities of the Campinas Group are carried out in the Mathematical Geophysics Laboratory. The Lab has many PC Linux workstations and Sun Ultra 60/80 workstations connected by a dedicated network, suitable for parallel processing. For large-scale applications, the Lab has full access to the National Center for High Performance Computing of São Paulo, that maintains, among other machines, an IBM RS/6000 9076-308 SP (43 nodes) with 120GB of RAM. Also available are seismic processing software packages from Paradigm and CGG.

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

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". Since 2005 he has been a Ph.D. student at the University of Hamburg. His present research interests include CRS imaging, migration velocity analysis, and depth inversion applied to deep seismic reflection data.

Ricardo Biloti received his BSc (1995), MSc (1998) as well as PhD (2001) in Applied Mathematics from the State University of Campinas (UNICAMP), Brazil. Since May 2002, he has been working for Federal University of Paraná (UFPR), Brazil, as an Adjoint Professor at the Department of Mathematics. Nevertheless he is still a collaborator of the Campinas Group. 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, SIAM, and SEG.

Stefan Buske received his diploma in geophysics (1994) from Frankfurt University. From 1994 until 1998, he worked as research associate at Frankfurt University, and from 1998 until 1999 he was with Ensign Geophysics Ltd. (Depth Imaging Department) in London. Since 1999 he is a university staff member at the Free University of Berlin. His research interests include seismic modeling and inversion, deep seismic sounding and parallel programming. He is a member of EAGE, SEG, AGU, ASA and DGG.

Klaus Mairan Laurido do Carmo received his BSc (2001) in Mathematics from the Federal University of Pará (Brazil). Presently, he is finishing his master's thesis entitled "Global Optimization methods applied in the search of the 2-D CRS stack parameters" at Federal University of Pará. His research interest is Applied Mathematics.

Daniel Chalbaud received his degree as Geophysical Engineer from Universidad Simon Bolivar (Caracas, Venezuela) in 2000. He worked in the Seismology Department of the Venezuelan Institute for Seismological Research (FUNVISIS). Also, he worked as Explorer Geophysicist for the Geophysical Data Acquisition Department of the Venezuelan Oil Company (PDVSA). Currently, he is working as a Ph.D student at Freie Universitaet Berlin. His research interests focus on seismic data processing, imaging and seismic data acquisition. Member of the SEG and SOVG.

Pedro Chira-Oliva received his MSc in 2000 and PhD in 2003 from Federal University of Pará (Brazil), both in Geophysics. His research interests are macro-model independent imaging methods, seismic image wave methods and 3D modeling. He is a member of SBGf and SEG.

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 his is Associate Professor in the Geophysics Department, UFPA. His fields of interest include seismic anisotropy, traveltime tomography and seismic modeling.

João 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. He is a member of SEG, EAGE, and SBGF. Actually, he is the Director of the National Department of the Mineral Production of the Pará Province.

Jaime Fernandes Eiras received his diploma in geology in 1975 from the Pará University, Brazil. He joined Petrobrás in 1976, where he worked as a wellsite geologist until 1983, and as an exploration geologist until 2001. Since March 2002, he has been a visiting professor at the Geophysics Department of the ParÚniversity. As a basin interpreter, he has studied many of Brazil's offshore and onshore areas, such as Atlantic-type, paleozoic, rift, and multicyclic basins. His fields of interest are structural, stratigraphic, and seismic interpretation, especially seismic stratigraphy. He is a member of the Brazilian Geological Society.

Carlos A.S. Ferreira received a BSc (1996) and a MSc (2000), both in physics, at Federal University of Pará. From 1997 to 2001, he spent some time studying geology, where he had the opportunity of working with some geophysical methods, such as vertical electric sounding and well logging, both as a geology graduate student. Presently, he is working towards his PhD in geophysics at Federal University of Pará, where the main topic of his thesis is prestack depth migration using Gaussian beams. His main research interests are quantum description via Ermakov invariants (in physics) and all forward and inverse seismic imaging techniques. He is member of SEG, SBPC and SBGf.

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 serves as an Associate Editor for Geophysical Prospecting (section anisotropy).

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.

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.

Kolja Gross studied physics at the Freie Universität Berlin and received his diploma in 2004. Since April 2004 he is working as a Ph.D. student on reflection seismic data. His research interests include seismic modeling, imaging techniques and scattering.

Zeno Heilmann received his diploma in Geophysics from the University of Karlsruhe (TH) in October 2002. Since November 2002 he has been a research associate at the Geophysical Institute, Karlsruhe University. Besides the practical application of the CRS stack based imaging workflow in several research projects, he works on the development of the CRS stack software, focusing on the influence of rugged topography and near surface velocity variations. He is a member of EAGE and SEG.

Peter Hubral received an M.Sc. in 1967 in geophysics from Clausthal Technical University and a Ph.D. in 1969 from Imperial College, London University. Since 1986, he has been a full Professor of Applied Geophysics at Karlsruhe University specialising in Seismic Wave Field Inversion. During 1970-73 he was with Burmah Oil of Australia and from 1974 to 1985 he was with the German Geological Survey in Hannover. He was a consultant in 1979 with AMOCO Research and, during 1983-1984, a Petrobras-sponsored visiting professor in the PPPG project at the Universidade Federal da Bahia in Brazil. In 1995-1996 he was an ELF- and IFP-sponsored visiting professor at the University of Pau, France. He received EAEG's Conrad Schlumberger Award in 1978, the SEG's Reginald Fessenden Award in 1979, and the EAGE's Erasmus Award in 2003. He is a regular member of DGG and an honorary member of the EAEG/EAGE and SEG. Peter Hubral is involved in most of WIT's activities, in particular those including research on image resolution, image refinement, image attributes, multiple suppression, incoherent noise suppression, true-amplitude imaging, interpretative processing, and image animation.

Florian Karpfinger is a diploma student. Presently, he is working at the reservoir characterization group at the Free University Berlin. He is a member of the SEG, DGG, and EAGE.

Tina Kaschwich received her diploma in 2000 in geophysics from Hamburg University. Since 2001 she has been a Ph.D. student at the University of Hamburg. Her research interests are ray method and migration in anisotropic media. She is a member of EAGE.

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.

Mareike Kienast is diploma student at the Geophysical Institute of Karlsruhe. She is currently working on the application of limited-aperture migration. She is member of EAGE.

Tilman Klüver received his diploma (with distinction) in geophysics from Karlsruhe University in February 2004. Since April 2004, he has been a research associate at Karlsruhe University. His research covers the application of kinematic wavefield attributes in 2D and 3D inversion schemes as well as their extraction from seismic datasets. He is a member of the EAGE and the SEG.

Ingo Koglin received his diploma in geophysics in 2002 from Karlsruhe University. Since 2002 he has been a research associate at Karlsruhe University. His research interests include preparation and application of seismic wavefield attributes obtained by the CRS stack. He uses the attributes for inversion and to improve imaging. A second field of interest is the improvement of the CRS stack by means of residual static correction. He is a member of EAGE and SEG.

Oliver Krüger received his diploma in geophysics in 2002 from Freie Universität Berlin and is currently a PhD student at Freie Universität Berlin. His research interests focus on finite difference modeling, imaging and property prediction of fractured materials.

L.W.B. Leite is a professor of geophysics at the Graduate Course in Geophysics, and member of the Department of Geophysics of the Federal University of Pará (Belem, Brazil). His main emphasis at the present time is seismic wave propagation in thin layers for deconvolution and inversion problems.

Rômulo Correa Lima received his diploma in geophysics in 2002 from Geophysical Department of the Federal University of Pará, Brazil, with a thesis on Seismic Migration. In 2002 and 2003, he was a researcher in the seismic group of that university. Currently he is working on 3D modeling.

Jürgen Mann received his diploma in geophysics in 1998 from the Faculty of Physics, Karlsruhe University, with a thesis on Seismic Image Waves. In 2002, he received a doctorate in natural sciences (with distinction), again from the Faculty of Physics in Karlsruhe, with a thesis on the Common-Reflection-Surface Stack method. Since 1998 he has been a research associate at Karlsruhe University, since 2001 he is assistant to Prof. Peter Hubral. His fields of interest are seismic reflection imaging methods, especially data-driven approaches based on kinematic wavefield attributes. He is active member of the SEG, member of the EAGE and its research committee, and member of the editorial board of the Journal of Seismic Exploration.

Nils-Alexander Müller received his diploma in geophysics in December 2003 from Karlsruhe University, Germany. His thesis dealt with the implementation of the 3D CRS stack. Since 2004 he has been a research associate at the Geophysical Institute in Karlsruhe. His research covers the 3D CRS stack and the application of the kinematic wavefield attributes in 3D inversion algorithms. Alex is also responsible for the WIT report. He is a member of EAGE and SEG.

Tobias M. Müller received a diploma in geophysics in 1998 from Karlsruhe University and his PhD in 2001 from Free University Berlin. Since 2002 he has been a post-doctoral fellow of the Deutsche Forschungsgemeinschaft at Curtin University of Technology in Perth. His research interests include seismic waves in random media and rock physics. He is a member of DGG, EAGE, and SEG.

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Claudia Payne has been Peter Hubral's secretary since 1990. She is in charge of all WIT administrative tasks, including advertising, arranging meetings, etc. Email: Claudia.Payne@gpi.uka.de; phone: +49-721-608-4443, fax: +49-721-71173

Rodrigo Portugal received his B.Sc. (1995), M.Sc. (1998), and PhD (2002) in Applied Mathematics from the State University of Campinas (UNICAMP), Brasil. In his thesis he studied wavefront construction in the 2.5D situation and its application to the four Kirchhoff operations, namely: modeling, migration, demigration and demodeling. Currently he is an associate researcher of the Department of Geology and Natural Resources (DGRN) at UNICAMP. His research interests include wavefront propagation, numerical analysis, seismic imaging and inversion.

Lasse Rabenstein is a diploma student. He is currently working as a teaching assistant for the department of Geophysics at the FU Berlin. His interests are seismic imaging and wave phenomena in random media.

Susanne Rentsch received her diploma in geophysics from the Free University Berlin in July 2003. Her diploma thesis was about "Hydraulic characterization of rocks using density of microseismicity". Since August 2003 she has been working as a PhD student on location of seismic events using imaging techniques.

Elmar Rothert received his diploma in Geophysics in 1999 from the University of Göttingen. In his diploma thesis he studied the scattering of teleseismic waves at small-scale heterogeneities in the crust and lithosphere below the seismic receiver array GRF in Germany. Since January 2000 he is a Ph.D. student of Prof. Shapiro at the Freie Universität Berlin. Currently, he focuses on the reconstruction of permeability in heterogeneous, anisotropic, fluid-saturated media from induced microseismicity. He is a member of AGU, EAGE, and SEG.

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