Fall Meeting Announcement

The Fall 2012 Research Meeting of TCCS will take place in Austin, TX, November 12–13 and will be hosted by the Bureau of Economic Geology on the J. J. Pickle Research Campus.

Representatives of participating companies are invited to register for the meeting by following the link at http://www.beg.utexas.edu/tccs/

Editorial

Welcome to the second TCCS Newsletter!

The Texas Consortium for Computational Seismology (TCCS) is a joint initiative of the Bureau of Economic Geology (BEG) and the Center for Numerical Analysis at the Institute for Computational Engineering and Science (ICES) at The University of Texas at Austin. Its mission is to address the most important and challenging research problems in computational geophysics as experienced by the energy industry while educating the next generation of research geophysicist and computational scientists. In the second issue of the TCCS Newsletter, you will find the latest news about our group’s research, presentations by our members at the upcoming SEG Annual Meeting, and our new staff members. We are looking forward to your feedback, suggestions, and requests for research collaboration. See you in Las Vegas and Austin!

TCCS Sponsors

TCCS appreciates the support of its sponsors: BGP, BP, Chevron, CGGVeritas, ConocoPhillips, ExxonMobil, Hess, Saudi Aramco, Schlumberger, Statoil, Total, and Z-Terra.

For sponsorship opportunities, please contact sergey.fomel@beg.utexas.edu.

Presentations at SEG in Las Vegas

TCCS members and guests will make several presentations at the upcoming SEG 2012 Annual Meeting in Las Vegas.

<table>
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<tr>
<th>Time</th>
<th>Session</th>
<th>Presenters</th>
<th>Title</th>
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<tr>
<td>Monday, Nov. 5</td>
<td>1:50 pm</td>
<td>SVE E-P1: Miscellaneous Approaches</td>
<td>Y. Tao, M. Davidson, H. Swan, S. Fomel, J. Malloy, J. Howell, S. Chiu, and R. Olson</td>
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<tr>
<td>2:45 pm</td>
<td>ANI 1: Theory Development and Case Studies</td>
<td>J. Cheng and W. Kang</td>
<td>Propagating pure wave modes in general anisotropic media, Part I: P-wave propagator</td>
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<td>3:10 pm</td>
<td>ANI 1: Theory Development and Case Studies</td>
<td>T. Wang, J. Cheng, and W. Kang</td>
<td>Pure-mode modeling and reverse-time migration of P-wave in HTI and orthorhombic media</td>
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<td>3:10 pm</td>
<td>ANI E-P1: Development and Application</td>
<td>W. Kang and J. Cheng</td>
<td>Propagating pure wave modes in general anisotropic media, Part II: SV and SH waves</td>
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<tr>
<td>4:00 pm</td>
<td>SPMA 1: Matrix Decomposition, Regularization, and Interpolation</td>
<td>S. Fomel</td>
<td>Seismic data decomposition into spectral components using regularized nonstationary autoregression</td>
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<tr>
<td>Tuesday, Nov. 6</td>
<td>1:30 pm</td>
<td>SM P2: From Rays to Rock Physics</td>
<td>C. Wang, J. Cheng, and W. Kang</td>
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<td>4:00 pm</td>
<td>SPMJ 2: Gatherers and Velocity Analysis</td>
<td>A. Klokov and S. Fomel</td>
<td>Optimal migration aperture for conflicting dips</td>
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<tr>
<td>8:55 am</td>
<td>SVE 3: Tomography</td>
<td>S. Li, S. Fomel, and A. Vladimirsly</td>
<td>Prestack first-break traveltome tomography using the double-square-root eikonal equation</td>
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<tr>
<td>1:30 pm</td>
<td>SM 2: Theory</td>
<td>J. Poulson, B. Engquist, S. Li, and L. Ying</td>
<td>A parallel sweeping preconditioner for frequency-domain seismic wave propagation</td>
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<tr>
<td>1:50 pm</td>
<td>ANI P1: Theory Development and Case Studies</td>
<td>X. Song and T. Alkhalifah</td>
<td>Modeling of pseudo-acoustic P-waves in orthorhombic media with low-rank approximation</td>
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<tr>
<td>1:50 pm</td>
<td>SPMUL E-P1: Prediction and Subtraction</td>
<td>J. Hu, S. Fomel, L. Demanet, and L. Ying</td>
<td>A fast butterfly algorithm for the hyperbolic Radon transform</td>
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<tr>
<td>3:10 pm</td>
<td>SPMUL E-P1: Prediction and Subtraction</td>
<td>S. Ghosh and S. Fomel</td>
<td>Multiple suppression in the r-x-p domain</td>
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<tr>
<td>Wednesday, Nov. 7</td>
<td>3:10 pm</td>
<td>SM 2: Theory</td>
<td>X. Song and T. Alkhalifah</td>
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<tr>
<td>3:35 pm</td>
<td>SM 2: Theory</td>
<td>X. Song, K. Nihei, and J. Stefani</td>
<td>Seismic modeling in acoustic variable-density media by Fourier finite differences</td>
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<tr>
<td>10:35 am</td>
<td>SPMJ 5: New Implementations</td>
<td>V. Bashkardin, T. J. Browweys, S. Fomel, F. Gao, S. Morton, S. Terentyee, and A. Vladimirsly</td>
<td>Phase-space computation of multiarrival traveltimes, Part II: Implementation and application to angle-domain imaging</td>
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<tr>
<td>11:00 am</td>
<td>INT 6: New Algorithms and Techniques</td>
<td>Y. Cai, S. Fomel, and H. Zeng</td>
<td>Spectral recomposition using separable nonlinear least squares</td>
</tr>
<tr>
<td>1:30 pm</td>
<td>W-17: Seismic Diffraction Methods for Fault and Fracture Detection</td>
<td>S. Fomel</td>
<td>Diffraction imaging as a tool for velocity estimation</td>
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Fast Hyperbolic Radon Transform

Jingwei Hu is working on fast algorithms for time-variant transforms, such as the hyperbolic Radon transform. Figure a is a synthetic CMP gather (Nt=Nx=1000). Figure b shows the result by the fast butterfly algorithm (Nt=Np=1000). For this number of data, the fast algorithm runs in only 1.74 seconds, while the conventional time-domain integration takes 62.46 seconds.

3-D Diffraction Imaging

Alexander Klokov has extended diffraction imaging with dip-angle gathers to 3D input data. This example demonstrates that a diffraction image allows us to distinguish discontinuities in the reservoir at time levels between 0.9 and 1.2 seconds. These features are not clearly visible after conventional imaging.

Helmholtz Solver with Spectral Elements

Paul Tsuji developed parallel sweeping preconditioners (based on the moving PML preconditioner presented by Engquist and Ying) for high-order spectral-element discretizations of Helmholtz and time-harmonic linear elasticity equations. For the Helmholtz equation, the SEG Overthrust problem was solved at 10 Hz (Fig. a) using 1024 processors and at 20 Hz (Fig. b) using 2,048 processors.

Migration Gallery

TCCS members have been busy completing the “migration gallery”: a matrix, in which rows correspond to benchmark datasets and columns correspond to different migration methods. So far, the matrix has 12 rows and 6 columns, not all of which are complete yet. Reproducible examples will be shared first with TCCS sponsors and eventually with the wide geophysical community so that students and researchers from other universities can contribute their own rows and columns.
Madagascar School

Madagascar is an actively developed open-source software package for geophysical data analysis and reproducible computational experiments. More than 50 people from different organizations around the world have participated in its development since 2006.

On July 20 and 21, 2011, some TCCS members participated in the Madagascar School on Reproducible Computational Geophysics in Austin. More than 40 people attended the school, representing 15 organizations (11 universities and 4 companies) from 5 different countries. One of the participants in the evaluation of Madagascar said: "I think it is the best open source project out there. I think that is not because of the programs (which are very good) themselves but because of the community and reproducibility framework."

The school materials are available now on the Madagascar website: http://www.ahay.org/wiki/Austin_2012.
TCCS Staff

The TCCS group consists of people from nine different countries who have come together to move science forward.

Our research staff includes Principal Investigators, Postdocs, Ph.D. students, M.S. students, B.S. Honors students, and a Senior Research Fellow:

Salah Al-Hadab (M.S. 3rd year)
Vladimir Bashkardin (Ph.D. 6th year)
Lubna Barghouty (B.S. Honors)
Yangkang Chen (Ph.D. 1st year)
Luke Decker (M.S. 1st year)
Björn Engquist (PI)
Sergey Fomel (PI)
Shaunak Ghosh (Ph.D. 2nd year)
Jingwei Hu (Postdoc)

Parvaneh Karimi (Ph.D. 5th year)
Alexander Klokov (Postdoc)
Siwei Li (Ph.D. 4th year)
Jack Poulson (Ph.D. 4th year)
Karl Schleicher (Senior Research Fellow)
Xiaolei Song (Ph.D. 5th year)
Yanadet Sripanich (B.S. Honors)
Junzhe Sun (Ph.D. 1st year)
Paul Tsuji (Ph.D. 3rd year)
Haizhao Yang (Ph.D. 2nd year)
Lexing Ying (PI)

For more information, see http://www.beg.utexas.edu/tccs/staff.php

Departing

At the end of 2012, Lexing Ying, one of the TCCS principal investigators, will depart UT Austin to start a position at Stanford University, where he will be affiliated with the Department of Mathematics and the Institute for Computational and Mathematical Engineering (ICME). We wish Lexing success in his new assignment and will continue active collaboration with him and his students. The TCCS Advisory Committee will meet in late November to develop recommendations on the program transition with Lexing’s departure from Austin.

In May 2012, Yihua Cai completed his M.S. thesis Spectral recomposition and multicomponent seismic image registration and joined Shell in Houston.

In September 2012, Paul Tsuji defended his Ph.D. thesis Fast algorithms for frequency-domain wave propagation. He is joining the Sandia National Laboratory in Livermore, California, as a postdoc.

In November 2012, Xiaolei Song is scheduled to defend her Ph.D. thesis Application of Fourier finite differences for seismic modeling and subsalt imaging. In 2013, she is planning to join BP in Houston.

In November 2012, Jack Poulson is scheduled to defend his Ph.D. thesis Fast parallel solution of heterogeneous 3D time-harmonic wave equations. In 2013, he will follow Lexing to Stanford as a postdoc.

In fall 2012, Salah Al-Hadab is completing his M.S. thesis Diffraction imaging of sediment drifts in Canterbury Basin and returning to Saudi Arabia, where he will continue his work at Saudi Aramco.

Arriving

Yangkang Chen graduated from China University of Petroleum (Beijing) with a B.S. degree in Exploration Geophysics. As an undergraduate, he worked with Profs. Xiaohong Chen and Jingye Li on research topics in rock physics and with Dr. Jittu Ma on multiple attenuation using L1-norm matching and noise attenuation using Empirical Mode Decomposition.

Junzhe Sun graduated from a joint education program between China University of Petroleum-East China and Missouri University of Science and Technology with a Bachelor’s degree in Geophysics in 2012. He worked with Prof. Stephen Gao on seismic anisotropy and mantle flow when he was at Missouri S&T.

Luke Decker earned a B.A. in physics with a minor in mathematics from Whitman College in 2008, authoring an honors thesis The effect of aluminum doping on the molecular sol gel silicate glasses. After graduation he went to work in the oilfield as a mudlogger for King Canyon Buffalo until December 2010, when he enrolled at Western Washington University to earn a B.A. in geophysics, which he completed in December 2011. After completing his Master’s, Luke hopes to join industry as an exploration geophysicist.

Jiubing Cheng, an Associate Professor from Tongji University, who was awarded a fellowship under the State Scholarship Fund, will spend 1 year at TCCS. His research interests include wave propagation, imaging and velocity model building in anisotropic media, fracture characterization based on azimuth-preserved local angle-domain seismic imaging, rock-facies classification and hydrocarbon prediction by integration of statistical rock physics and seismic inversion, and geophysical technique for shale-gas exploration and development.

Gang Fang has been awarded a scholarship under the China State Scholarship Fund. Gang is currently pursuing a Ph.D. in Geophysics at China University of Petroleum (East China) under the supervision of Prof. Qizhen Du. He received his Master’s degree in Geophysics from China University of Petroleum (Beijing). His research interests focus on true-amplitude seismic imaging for acoustic and elastic media.

Testimonials

Xiaolei Song:
“TCCS is like a big family for me, where people from multidisciplines work together. TCCS has also been building a great connection between academia and industry. During my 4-year stay, I learned a lot from people and grew to be an exploration geophysicist. I feel fortunate and proud to be part of the family.”

William Burnett, alumnus of TCCS and currently a geophysicist at ExxonMobil:
“It has been a privilege to be part of it and watch TCCS grow so quickly in the last few years. I look forward to watching the group develop even more—I know the best is yet to come!”