2000 MIDYEAR UTAM ACCOMPLISHMENTS


This last 6 months we developed several novel approaches to seismic processing, namely passive seismic imaging by crosscorrelation migration and interferometric statics. We also have improved the methods of wavepath migration and migration deconvolution.

- Passive seismic imaging. While on sabbatical at Stanford, Schuster developed a theory of passive seismic imaging, where seismic traces are passively recorded, crosscorrelated, and used to image the earth’s internal structure. The correlations of the direct wave with the free-surface ghost reflections are migrated to image the reflectivity distribution, and the direct-direct wave correlations are migrated to image the source distribution. Results with synthetic data show the promise of this methodology, but there are many challenges to be overcome before it is proven with field data. To understand these challenges, Jinmeng Sheng applied the passive imaging idea to Exxon’s Friendswood RVSP data and demonstrated the feasibility of passive imaging with field data. However, spurious events are still present in some parts of the migration image and his future task is to eliminate such events.

For the annual UTAM meeting, we hope to show results from passive seismic data we are scheduled to collect at the Tooele Army Depot and process according to the passive seismic theory. We also hope to test its application in migrating free-surface multiples with CDP data.

- Migration deconvolution. Jianxing Hu used an analytic migration Green’s function to construct a migration deconvolution (MD) filter, and deconvolve migration images associated with the SEG/EAGE overthrust data. The analytic Green’s function is valid for an homogeneous medium. Results show that the analytic MD filter performed well, but gave an image with acceptable, but slightly worse, quality compared to the MD filter constructed with ray tracing in an inhomogeneous media. But the benefit
is that the analytic MD filter required 4 times less CPU time to compute than the ray-based MD filter. This computational efficiency is expected to dramatically improve for 3-D migration images.

For the annual UTAM meeting, we hope to have further examples demonstrating the performance of migration deconvolution, particularly for prestack migration. Some examples from Hu’s 1999 UTAM report showed instability in prestack MD, so a key issue is to improve the robustness of prestack MD filtering. Jianxing has released preliminary versions of his 2-D and 3-D poststack migration deconvolution codes and they can be downloaded from the following site: http://utam.gg.utah.edu/codes/prel.html with the user ID: mirrorlake and mail Prof. Schuster to get the password. (schuster@mines.utah.edu)

- Wavepath migration. Hongchuan Sun applied wavepath migration (WM) to crosswell seismic data and to single-well seismic data. Results for synthetic data show that WM reduces some migration artifacts compared to Kirchhoff migration (KM) of the same data. He claims that image resolution has been slightly improved. Hongchuan has released a preliminary version of his 2-D and 3-D WM codes and they can be downloaded from the following site: http://utam.gg.utah.edu/codes/prel.html with the user ID: mirrorlake mail Prof. Schuster to get the password. (schuster@mines.utah.edu)

For the annual UTAM meeting, Hongchuan hopes to show the results of applying WM to field data from VSP, crosswell, and 3-D CDP experiments. He is also working on using migration velocity analysis with WM to expedite the update of the migration velocity model with 3-D and 2-D CDP data. He expects to show his first results with WM+MVA at the annual UTAM meeting.

- Reverse time migration and ghost imaging. Yue Wang applied multicomponent reverse time migration to 3-D synthetic data associated with the SEG/EAGE salt dome model. Results demonstrated that both the primary and free-surface ghost reflections can be imaged, and show a noticeable improvement in imaging reflectors below the salt boundary.

- Interferometric seismic imaging. Min Zhou demonstrates that traveltime interferometry with phase closure (IPC) can eliminate source and receiver
statics in traveltime data. However, the DC component of the data is also eliminated with IPC so that the IPC tomogram has less resolution than a standard tomogram without static errors in the data. Further improvements are needed to reduce the artifacts with this interesting new tomography method.

- Refraction tomography and reflection imaging. Dave Sheley and Jianhua Yu present several new case histories that show the power of combining refraction tomograms and reflectivity images to give increased confidence in the reflection record interpretation. The use of the VISTA processing software from Seisimage gave noticeably improved results compared to processing with a public-domain processing package. Dave Sheley and friends collected these data sets by a series of 2-D reflection surveys.

- Jianhua Yu developed a statics elimination method that relies on interferometric principles with phase closure. Results with synthetic and field data show the success of this method, and Jianhua soon hopes to compare it against field data examples that used the standard residual statics method.

We combined our 43 processor PC cluster with the 200+ PC processor cluster of the Center for High Performance Computing at the University of Utah. This shared arrangement is mutually beneficial, and allows us to efficiently test 3D migration algorithms.

Yue Wang defended his PhD dissertation in June, 2000 and began working full time for Chevron in August. Jing Chen worked for Amerada Hess this last summer, and is expected to defend his PhD dissertation sometime in October, 2000. Jianxing Hu worked for Advance Data Solutions this summer. Jerry Schuster enjoyed traveling to Dhahran and giving a week-long seismic-imaging course to Aramco in early September. On his return from Saudi Arabia, he stopped off in Cairo to meet with Cairo University and US Embassy officials about establishing a joint environmental geophysics project.

The annual UTAM meeting for the year 2000 sponsors will be held all day Tuesday Feb. 6 and Wednesday Feb. 7, 2001. The meeting will take place on campus in the INSCC auditorium In addition, the Center for High Performance Computing will host a 2-day conference on "Cluster Computing in the Sciences" from Feb. 8 to Feb. 9 on campus. All UTAM sponsors are invited to attend the cluster conference after the UTAM meeting. The theme of the
cluster conference will not be confined to Geophysics as it was in 1999, but there will be an afternoon session devoted to issues in Geophysical cluster computing. Speakers from industry, national labs, and other universities will share their views, knowledge, and experience in cluster computing. Similar to last year, short courses in the art of cluster computing will be offered to attendees; further details will be sent to you shortly.

We very much appreciate your support this last year. If your company plans to join the UTAM consortium for 2001, please submit the signed agreement (see next page) and the fee of $20,000. as soon as possible. This will help me plan properly for the 2001 year.

Thanks for your support.

Jerry Schuster (schuster@mines.utah.edu)
The Utah Tomography Modeling/Migration Consortium at the University of Utah is under the direction of Professor Gerald Schuster. UTAM is an educational program based in the university’s Department of Geology and Geophysics.

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The sponsor company below agrees to sponsor UTAM under the direction of Professor Schuster at the University of Utah from date until date for a contribution of $20,000. All benefits of membership are outlined above.

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