



## Mission-Oriented Seismic Research Program

### 2016 Annual Technical Review and Meeting

UH Hilton

4800 Calhoun Road, Houston, Texas, 77004

(On the UH Main Campus, entrance 4 (four), University Drive off Calhoun Road,  
Under-ground parking, at the hotel)

The meeting and breakfast will be in the Plaza Room and lunch is in Shamrock A.

The dinner on Thursday, June 9th at 6:00PM is in Shamrock A.

### AGENDA

#### *Wednesday, June 8, 2016*

**8:00 AM** Welcome, breakfast/reception

**8:30 AM** Technical Program begins: Meeting Overview—IDENTIFYING AND RESPONDING TO PRIORITIZED AND PRESSING SEISMIC EXPLORATION CHALLENGES

#### **ESSENTIAL PREPROCESSING FOR EFFECTIVE MULTIPLE REMOVAL, DEPTH IMAGING AND INVERSION: REMOVING THE REFERENCE WAVE-FIELD, GROUND ROLL, AND GHOSTS FOR OFFSHORE, OBC AND ONSHORE PLAYS, AND WITHOUT DAMAGING REFLECTION DATA**

Green's theorem tutorial Part I: for wave field separation (separation of reference and scattered wave-fields, and for de-ghosting)

*Arthur B. Weglein\**

**9:15 AM** Predicting deghosted pressure and multicomponent displacements at the ocean bottom

*Jing Wu\**

**9:45 AM** Using depth-variable towed streamers for offshore preprocessing in the  $(x-\omega)$  domain to predict scattered wave and receiver deghosted data above the streamers -- towards on-shore and ocean bottom application with variable topography.

*Zhen Zhang\**

**10:05 AM** Onshore preprocessing: (1) reference wave removal including ground roll and deghosting, and (2) achieving that objective with a reduced data requirement

*Jing Wu\**

- 10:30 AM** Morning break
- 11: 00 AM** The significance and impact of incorporating a 3D point source in deghosting for data coming from a 1D subsurface  
*Xinglu Lin\**
- 11:30 AM** Lunch
- 12:30 PM** A new method for deghosting on a depth variable acquisition surface by combining Green's theorem and a Stolt extended Claerbout III wave prediction for one way propagating waves  
*Jing Wu\**
- 1:10 PM** Initial tests for the new two-step strategy of deghosting that combines Green's theorem and a Stolt extended Claerbout III wave prediction for one way propagating wave on a non-horizontal measurement surface for marine case  
*Yuchang Shen\* and Zhen Zhang*
- 1:35 PM** Afternoon break

**A NEW AND FIRST MIGRATION METHOD THAT IS EQUALLY EFFECTIVE AT ALL RECORDED FREQUENCIES: STOLT EXTENDED CLAERBOUT III MIGRATION FOR A MEDIUM FOR TWO WAY PROPAGATING WAVES. A TOOL FOR PROVIDING A DEFINITIVE RESPONSE TO “ MULTIPLES: SIGNAL OR NOISE? ”.**

- 2:15 PM** Green’s theorem tutorial Part II: for wave field prediction: imaging conditions, one-way and two-way wave equation migration for a more effective and fundamentally and practically more capable migration (Stolt extended Claerbout III imaging for migrating in a volume with two way propagating waves)  
(Glossary of imaging conditions: in our usage, Claerbout imaging I is the exploding reflector model, Claerbout II imaging , is the space and time coincidence of up and downgoing waves, and Claerbout III refers to predicting a coincident source and receiver experiment at depth at time equals zero.) These migration methods require a velocity model.  
*Arthur B. Weglein\**

The Claerbout II imaging principle resides behind all current leading edge RTM methods used in industry. Claerbout II and all RTM methods are intrinsically high frequency approximations independent of how they are extended or implemented. . Benefits of the new Stolt extended Claerbout III imaging for two way propagating waves: (1) provides a new and first migration method that’s equally effective at all recorded frequencies at the target and reservoir and hence added-value and advantages for both structural

determination and amplitude analysis in migration and (2) provides clarity on the role of primaries and multiples in imaging and migration

Stolt extended Claerbout III imaging for two way propagating waves provides a clear and definitive response to the role of primaries and multiples in imaging and inversion: Multiples: signal or noise?

*Arthur B. Weglein\**

Only primaries are required for imaging and inversion, but when there is inadequate acquisition of primaries, multiples can be used to provide an approximate image of an unrecorded primary

*Thursday, June 9, 2016*

**PIONEERING, DEVELOPING AND DELIVERING A RESPONSE TO THE PRIORITIZED AND PRESSING INDUSTRY CHALLENGE AND NEED FOR A NEXT GENERATION OF INCREASED MULTIPLE REMOVAL CAPABILITY: A KEY OBJECTIVE AND M-OSRP PROJECT**

**8:30 AM** A tutorial on the inverse scattering series: distinct isolated task subseries for removing free surface and internal multiples

*Arthur B. Weglein\**

**Multiples: part I: Background/Introduction/Update**

**9:15 AM** Multiple attenuation: recent progress, and a plan to address open, prioritized and pressing issues and challenges

*Arthur B. Weglein\**

**10:00 AM** Morning Break

**10:15 AM** Thesis executive summary: On-shore ISS internal multiple attenuation: first field data tests

*Qiang Fu \**

**10:40 AM** **Multiples: part II: Advances to enhance the effectiveness of free surface multiple elimination and internal multiple attenuation algorithms**

The first Inverse-Scattering-Series internal multiple elimination method for a multi-dimensional subsurface

*Yanglei Zou\*, Chao Ma and Arthur B. Weglein*

**11:00 AM** **Thesis executive summary plus recent advances:** positive impact of incorporating a 3D point source in the processing steps (deghosting, multiple removal) for a 1D/2D subsurface

*Xinglu Lin\**

**11:30 AM** Lunch

**12:30 PM** An alternative Inverse-Scattering-Series (ISS) internal multiple eliminator for the first-order internal multiples generated by the ocean bottom  
*Xinglu Lin\**

**1:00 PM** Afternoon Break

**Multiples: part III: Beyond internal multiple attenuation: algorithms for *eliminating* internal multiples and *spurious events*, providing essential and necessary added value when there are numerous generators and interfering and proximal primaries and multiples**

**1:35 PM** **Thesis executive summary Part I**, A new Inverse Scattering Series (ISS) internal-multiple-attenuation algorithm that both predicts the exact time and approximate amplitude of first-order internal multiples and addresses and reduces spurious events.  
*Chao Ma\**

**THE NEW AND FIRST TWO WAY PROPAGATING WAVE MIGRATION METHOD THAT IS EQUALLY EFFECTIVE AT ALL FREQUENCIES AT THE TARGET AND RESERVOIR AND CAN ACCOMMODATE SPECULAR AND NON SPECULAR REFLECTIONS**

**2:05 PM** Stolt extended Claerbout III imaging for one way and two way wave migration: a new and more capable migration method  
*Arthur B. Weglein\**

The Claerbout II (CII) imaging condition (current leading edge RTM) removing back -scatter artifacts  
*Qiang Fu\**

An analysis and comparison of Stolt extended Claerbout III imaging condition for one waves (pre-stack Stolt FK migration) and its asymptotic Kirchhoff migration  
*Yanglei Zou\*, Qiang Fu, Chao Ma, Jing Wu and Arthur B. Weglein*

Analysis and comparison of Claerbout II imaging (current leading edge RTM) for one way propagating waves and Claerbout III imaging for one way propagating waves  
*Yanglei Zou\* and Qiang Fu*

Claerbout III imaging for structure and amplitude analysis beneath a reflector: opportunity for multiple elimination  
*Qiang Fu\**

The comparison of structural resolution differences with conventional and broadband data between CII and CIII--Part I  
*Qiang Fu\*, Yanglei Zou, Chao Ma and Arthur B. Weglein*

The comparison of structural resolution differences with conventional and broadband data between CII and CIII--Part II

*Yanglei Zou\**, *Qiang Fu*, *Chao Ma* and *Arthur B. Weglein*

Green's function for the new Stolt extended Claerbout III migration for a laterally and vertically varying medium, that will be equally effective at all recorded frequencies at the target and reservoir

**3:10 PM -3:25 PM** *Fang Liu and Arthur B. Weglein \**

**3:10 PM** Afternoon break

**3: 35 PM** **Thesis executive summary Part II**, A clear example of using multiples to enhance seismic imaging -- providing an approximate CII image of an un-recorded primary

*Chao Ma\**

**4:00 PM** What's the big picture, bottom line and our seismic imaging and inversion strategy with respect to primaries and multiples----the updated seismic processing chain.

*Arthur B. Weglein\**

**4:10 PM** **Amplitude analysis: Direct and indirect inverse solutions and a comparison with iterative linear inverse (the latter resides behind current AVO/FWI)**

A direct inverse solution for AVO/FWI parameter estimation objectives-opportunity for velocity analysis

*Arthur B. Weglein\**

**4:30 PM** **Providing an option and opportunity that combines 'what to compute' with 'how to compute', delivering a cost effective solution in a capital expenditure reduced industry environment**

Update: (1)The IBM Cloud HPC pay as you use proposal, (2) the Cloud POC pilot and (3) the ConocoPhillips ISS internal multiple speed-up--- and option and opportunity to start a company to provide an interface and delivery

*Arthur B. Weglein*

*Chris Porter, IBM, Manager, IBM High Performance Services, World Wide Offering*

**5:00 PM** Meeting Summary and adjournment

*Arthur B. Weglein\**

**6:00 PM** Reception and dinner, UH Hilton Shamrock Room A