The Center for Wave Phenomena (CWP) is an interdisciplinary research and graduate education program, dedicated to the study of wave propagation in complex media, imaging and inversion. A primary focus of the program is on seismic modeling, imaging and inversion methods, as well as on improving the accuracy and efficiency of seismic processing algorithms, especially for application to regions of structural complexity.

Part of CWP is the Consortium Project on Seismic Inverse Methods for Complex Structures (“Consortium,”) an international group of industry sponsors. We are associated with the Department of Geophysics at the Colorado School of Mines (CSM), a public research university dedicated to engineering and applied sciences.

CWP faculty have a broad range of research interests and thrive on solving problems of practical interest to the exploration industry. CWP faculty are: Paul Sava (CWP Director), Roel Snieder and Ilya Tsvankin. University Professors Emeriti and former CWP Directors Norm Bleistein and Ken Larner continue to work with CWP on a broad range of research interests. Over the years, CWP research directions have expanded to reflect the talents of our faculty and students, as well as to meet the needs and interests of our Consortium sponsors.

CWP is strongly committed to quality graduate education in geophysics. CWP students form an international group with a wide range of study and research interests. Their backgrounds are primarily in earth sciences, applied mathematics, computer science and physics. CWP graduates are recruited for employment by industry, government and academia following the completion of their degrees from CSM.

For additional information regarding CWP or the Consortium, visit our website at cwp.mines.edu or contact us at cwpinfo@mines.edu.
Paul SAVA - CWP Director

Paul Sava is the C. H. Green Chair of Exploration Geophysics at the Colorado School of Mines, and is the current CWP Director. He holds an Engineering degree in geophysics (1995) from the University of Bucharest, and an M.Sc. (1998) and a Ph.D. (2004) in geophysics from Stanford University, where he was a member of the Stanford Exploration Project. His main research interests are in wavefield seismic imaging, stochastic imaging and inversion, computational methods for wave propagation, numeric optimization and high performance computing. He is a recipient of a Stanford Graduate Fellowship (1997-2000) from Stanford University and of a Jackson Young Scientist Fellowship (2006-2007) from the University of Texas (Austin). He is also a recipient of three Awards of Merit for best student presentations at the Society of Exploration Geophysicists (SEG) conventions (1999, 2001 and 2004) and of a Honorable Mention in the Best Paper in GEOPHYSICS category (2003) for "Angle-domain common-image gathers by wavefield continuation methods," co-authored by Sergey Fomel. The SEG recognized him in 2007 with the Reginald Fessenden Award for his work on wave-equation angle-domain imaging. He is a member of SEG, EAGE, and AGU, and is currently serving his second term as Education Officer on the EAGE Board.

Roel SNIEDER - Professor

Roel Snieder holds the W. M. Keck Foundation Distinguished Chair in Basic Exploration Science at the Colorado School of Mines. He received a Master's Degree in geophysical fluid dynamics from Princeton University in 1984 and a Ph.D. in seismology from Utrecht University in 1987. From 1997 to 2000, he was chairman of the Faculty of Earth Sciences at Utrecht University. In 2000, he was elected as a Fellow of the American Geophysical Union (AGU) for important contributions to geophysical inverse theory, seismic tomography, and the theory of surface waves. He has been a member of the Earth Sciences Council of the U.S. Department of Energy from 2003 to 2011. The second edition of his book, A Guided Tour of Mathematical Methods for the Physical Sciences, was published in September 2004. In 2008, Roel worked for the Global Climate and Energy Project at Stanford University on global energy outreach and education. Roel and Ken Larner are co-authors of The Art of Being a Scientist, which was published in August 2009. He serves on the Society of Exploration Geophysicists (SEG) committee, Geoscientists Without Borders, as well as on the Editorial Boards of the Journal of the Acoustical Society of America and the European Journal of Physics. Roel is a foreign member of the Royal Netherlands Academy of Arts and Sciences and he was elected as Honorary Member of the Society of Exploration Geophysicists in 2011. He served as CWP Director from June 2008 to May 2011. Roel was a firefighter with Genesee Fire Rescue from 2000-2014 where he served the last two years as Fire Chief. He received a research award from the Alexander von Humboldt Foundation in 2014.
Ilya TSVANKIN - Professor

Ilya Tsvankin is a Professor of Geophysics at the Colorado School of Mines, who served a four-year term as CWP Director from 2004-08. He received his Ph.D. in geophysics from Moscow State University in Russia. Before coming to CWP, Ilya worked as deputy head of the laboratory “Geophysics of Anisotropic Media” at the Institute of Physics of the Earth in Moscow and then as a consultant to Amoco Production Research in Tulsa, OK. His research interests are in seismic wave propagation, seismic processing, and fracture characterization, particularly in developing inversion and processing methods for anisotropic media. The third edition of Ilya's widely used monograph, *Seismic Signatures and Analysis of Reflection Data in Anisotropic Media*, came out in 2012 (SEG, Geophysical References Series). In 2011 SEG published his new book, *Seismology of Azimuthally Anisotropic Media and Seismic Fracture Characterization*, co-authored by Ilya's long-time collaborator Vladimir Grechka of Marathon Oil. Since 2002, Vladimir and Ilya have been teaching a short course on seismic anisotropy as part of the SEG Continuing Education Program. Ilya is the recipient of the SEG Virgil Kauffman Gold Medal for outstanding contribution to the advancement of the science of geophysical exploration (1996). He also received the Best Paper in *Geophysics* Award from SEG in 2009 for a paper on attenuation anisotropy co-authored with his former student Jyoti Behura. In May 2011, he was elected a Fellow of the Institute of Physics (IOP), a leading international physics society.
University Professors Emeriti

Norman BLEISTEIN

Norman Bleistein was a CWP research leader from its inception in 1984 until he retired in 1999, serving as CWP Director until 1996. After receiving his Ph.D. in 1965 from the Courant Institute of Mathematical Sciences at New York University, he spent three years as an assistant professor at the Massachusetts Institute of Technology and fourteen years at Denver University before moving to the Colorado School of Mines. After Norm’s retirement from the Department of Mathematical and Computer Sciences in September 1999, he has remained active with CWP as University Professor Emeritus and Research Professor in Geophysics. He continues research in asymptotic analysis of seismic modeling, migration and inversion; his textbook, *Mathematics of Multidimensional Imaging, Migration and Inversion*, co-authored by John Stockwell and Jack Cohen, was published in January 2001. This was his third book, the others being on asymptotic expansions of integrals and on the mathematics of wave phenomena. More recent research has focused on the application of Gaussian beams to modeling, migration and inversion. He visited the University of Karlsruhe as a Senior Alexander von Humboldt American Fellow. In 2005, Norm was awarded the lifetime achievement award of Honorary Membership by the SEG. His presentation at that meeting on modeling with one-way wave equations near caustics was designated as one of the top 25 papers. In 2006, a paper co-authored with Yu Zhang and Guan-quan Zhang received the Best Paper Award in *Geophysics* for 2005. His presentation at the 2008 SEG meeting was ranked among the top 30, the fourth consecutive year for that honor. In 2014, he received the prestigious Maurice Ewing Medal, the highest recognition awarded by SEG.

Ken LARNER

In 2004, University Professor Emeritus Ken Larner retired as the Charles Henry Green Professor of Exploration Geophysics at the Colorado School of Mines and as CWP Director; he remains actively involved with CWP. After receiving his Ph.D. in geophysics from the Massachusetts Institute of Technology in 1970, he joined Western Geophysical Company where he became vice president for geophysical research in 1979. The recipient of the 1988 Conrad Schlumberger Award of the EAGE, he was Spring 1988 SEG Distinguished Lecturer and SEG president for 1988-89. He received the President’s Award for CSM Outstanding Educator in 1992. In 1996, he received the SEG’s most prestigious honor, the Maurice Ewing Medal. He was the Society of Petroleum Engineers Distinguished Lecturer for 2000-2001. Ken was awarded the P.L. Kapitsa Gold Medal by the Russian Academy of Natural Sciences in 2003. In 2008, he co-authored the book *The art of being a scientist: A guide to graduate students and their mentors* with Roel Snieder. Since 2013, Ken has been teaching the five-week course, Professional Oral Communication, primarily for CSM geophysics graduate students.
Shingo Sean ISHIDA - Communications

Shingo manages CWP’s communications, marketing and outreach efforts. He oversees the CWP website and he launched CWP’s YouTube and Vimeo channels. Shingo joined CWP in 2011, after working in communications at the Colorado Department of Public Health and Environment. Before moving to Colorado, Shingo worked as a bilingual news producer for a Japanese TV network in Washington, D.C. He also lived in Tokyo for three years and worked for the Japanese government. Outside of work, Shingo enjoys QT with his wife Catherine and his son Kento, playing softball in the Colorado State Employee Softball League, riding his motorbike, lighting up his BBQ grill, binge-watching on Netflix (Breaking Bad, The Walking Dead, House of Cards, Orange is the New Black), as well as most outdoor activities except skyaking. He supports the Colorado Rockies despite their atrocious record over the past several seasons and the simply ludicrous prices of their ballpark hot dogs. Although he has never attended a Denver Broncos match in person, he jumped on the bandwagon to support them when they made it to, and subsequently got destroyed at, the 2014 Super Bowl. Shingo - hailing from Vancouver, in beautiful British Columbia - recently celebrated another anniversary as a State of Colorado employee with a cup of really dark coffee and more work projects. Shingo lives somewhere in Denver’s vast suburbia and he is quite sure that he has a longer way to go on his mortgage than you. He likes dogs, but he can’t get himself to own one.

Pamela KRAUS - Program Assistant

Pamela manages the Center for Wave Phenomena office and provides administrative, technical and organization support for the Center. She coordinates all logistics for the CWP Project Review Meeting and the CWP Semi-Annual Meeting, held in conjunction with the Society of Exploration Geophysicists (SEG) annual meeting, originates Consortium contracts, graduate student contracts and oversees all Center budget work. Pamela has worked for the State of Colorado since April 1982, where she began her career at Colorado State University in Fort Collins, Colorado, and joined CWP in January 2009.

Pamela is a fourth generation Colorado native, which she is proud of. In her spare time, she enjoys spending time with her husband David and family. She became a grandma in November 2013 to granddaughter Teeghan and will become a grandma again in January 2016 to a grandson. Pamela enjoys spending time at her dad’s summer home in Red Feather Lakes, Colorado and every March enjoys spending a week in Tucson, Arizona at his winter home where she plans to retire to, but only in the winter months. Pamela’s passion is campaigning for Multiple Sclerosis, which she was diagnosed with in August 2012, and someday hopes they find a cure.
CWP Administration

John STOCKWELL - Research Associate

John is a research associate with CWP. He is the principal investigator of the Seismic Unix (SU) project, managing the popular CWP/SU open-source software package. SU is the world's first and most widely used open-source seismic research and processing environments. For his work with SU, John was co-recipient with Jack K. Cohen of the 1994 University to Industry Award from the Technology Transfer Society, and was co-recipient of a Special Commendation of Award from the Society of Exploration Geophysicists (SEG) with Einar Kjartannson, Shuki Ronen and Jack K. Cohen (posthumous). John uses SU as the basis of the Seismic Processing Lab course that he teaches each Fall semester at the Colorado School of Mines and he is presently developing a text book on seismic data processing with SU. John is the CWP Consortium contact regarding confidential software packages and manages the CWP computer system that includes several types of Linux systems. John is co-author of Mathematics of Multidimensional Seismic Imaging, Migration and Inversion, with Norm Bleistein and Jack Cohen. John teaches the graduate level course Mathematics of Seismic Imaging and Migration using this text. He expresses his ongoing passion for mathematics by teaching an informal seminar in Mathematics for Geophysicists. The notes collected from seven years of this provide the basis of a new textbook that John has just started compiling. John received a Distinguished Volunteer Award from the SEG Foundation in 2005 for his Timelines of Geoscience and Geophysics and of Exploration Geophysics and the Petroleum Industry. John is the Editor of the Bright Spots column in The Leading Edge, the Wiki Administrator of the new SEG Wiki (http://wiki.seg.org) and sits on several SEG Committees, including as the Chair of the SEG Wiki Committee and the Historic Preservation Committee. John received the SEG Presidential Award in 2014 for his work on the SEG Wiki and for his continuing work with SU, as well as the SEG Wiki Champion Award in 2014.

Diane WITTERS - Writing Consultant/Communication Coach

Diane teaches technical writing, coaches students on conference presentations, provides transition tools for efficient integration into the CWP community, and supports students as they develop into confident and effective writers, presenters, and collaborators within our diverse international group. In addition to her core work at CWP, Diane teaches a professional skills course to graduate students in different departments, offers various communication workshops through the CSM Writing Center, mentors a group of women scientists and engineers, and is developing an online resource and discussion board for students to dialog with each other about ethics in their degree programs and careers. She received a Bachelor of Arts degree in cultural anthropology from Principia College in Illinois and completed a graduate field study (organized through Northwestern University) on the Navajo Reservation in Arizona; this consisted of ethnographic research on bilingual/bicultural education within a Native American community. She also earned a Master of Arts in Language Teaching degree from the School for International Training, Vermont, with certification in English as a Second Language, Spanish and Multi-Cultural Education.

Diane has a passion for wild spaces and slips into the mountains and canyons for trail running, backpacking, canoeing, biking, and cross-country skiing.
**CWP Students**

**Lucas ANDRADE DE ALMEIDA**

Degree Program: PhD, Geophysics  
Country: Brazil

Lucas graduated in 2013 from the Universidade Federal da Bahia (UFBA) in Brazil, with a Bachelor of Science degree in geophysics. His undergraduate research centered on multiresolution transforms and its applications on seismic processing. In 2015, Lucas obtained his Master of Science degree in applied geophysics from UFBA, along with a Specialization degree in petroleum engineering. His graduate studies continued on the same research topic as his undergraduate research, for which he was awarded a fellowship from the Agência Nacional de Petróleo (ANP).

Lucas joined CWP in August 2015 and his advisor is Prof. Paul Sava. Outside of geophysics research, he enjoys reading, playing chess and running.

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**Elias ARIAS**

Degree Program: MS, Geophysics  
Country: USA

Elias received his Bachelor of Science degree in Geophysical Engineering from the Colorado School of Mines while competing on the school’s wrestling team. He held five internship positions, first at Landmark during the summer 2012 where he worked as a Java developer implementing a wellbore analyzer plug-in for Landmark. This tool was presented at the SEG annual meeting 2012 held in Las Vegas. Following his graduation from Mines, Elias interned at BHP Billiton working in the Quantitative Interpretation (QI) group creating rock physics templates for seismic data evaluation. After finishing his first year with CWP, Elias returned to BHP Billiton to work with the Eagle Ford production team on a Hawkville field study. During the fall 2014 semester, he took a leave of absence to work an internship with ExxonMobil working with the geophysical applications group (GAPS) on an exploration project in the Gulf of Mexico. He returned to CWP in the spring semester 2015. During the summer 2015, Elias joined Petroleum Geo-Services (PGS) as a research intern in their imaging and engineering team. During his time with PGS, he integrated and implemented the smooth dynamic warping algorithm in their internal software package for use in slope estimation and other technologies. He joined CWP during the fall 2013 under the guidance of Prof. Dave Hale.

Elias' hobbies include: staying physically fit, being outdoors, and spending time with friends, family, and his dog.

**Research**

Elias is currently working on estimating seismic reflection slopes. The implications of this research include improving coherent noise reduction filters, automatic horizon extraction, and fault mapping among other processes that require slopes as input. His research and work interests include: Geophysical computing, image processing, seismic imaging, formation evaluation, well log analysis, rock physics.
Yogesh ARORA
Degree Program: PhD, Geophysics
Country: India

In 2013, Yogesh graduated from the Indian School of Mines in Dhanbad, with his Bachelor and Master of Science degrees in applied geophysics via a five-year program. He completed his Master’s thesis with the Gas Hydrate research group of National Institute of Oceanography, Goa. For his Master’s thesis, he estimated P-wave anisotropic parameters in orthotropic media containing two sets of mutually orthogonal fractures in isotropic background. This model aims to resemble the Gas Hydrate occurrences in the Krishna-Godavari (KG) basin located in southern India. His CWP advisor is Prof. Ilya Tsvankin. Yogesh’s research interests are seismic anisotropy, seismic imaging and inversion.

Yogesh’s hobbies include: hiking, playing tennis and trying exotic cuisine.

Research
Yogesh is currently working on diffraction processing for anisotropic models for imaging and inversion. His aim is to make diffractions part of the anisotropic parameter estimation. He uses ray-based methods like Kirchhoff migration for creating images from just diffractions and building angle domain common image gathers.

Tong BAI
Degree Program: PhD, Geophysics
Country: China

Tong received his Bachelor of Engineering degree in geophysics from China University of Petroleum, Beijing. He switched to petroleum geology at graduate school, focusing on the migration path of tight sand gas in Western Sichuan Province. He also explored the distribution and attributes of fractures in that area. He joined CWP in August 2013 and his advisor is Prof. Ilya Tsvankin. His research interests include modeling and inversion in attenuative anisotropic media. Outside of geophysics, Tong enjoys sports, traveling and movies.

Research
Tong uses time-domain Finite-difference method for attenuation anisotropy modeling under the assumption of constant-Q theory. Currently, he is conducting viscoelastic FWI to recover attenuation parameters in VTI media, using the adjoint-state method.
CWP Students

Esteban DÍAZ PANTIN
Degree Program: PhD, Geophysics
Country: Venezuela

Esteban is a geophysical engineer who graduated from Universidad Simón Bolívar (USB) in Caracas Venezuela, in 2008. After obtaining his Bachelor of Science degree, Esteban worked in seismic data processing, depth imaging, as well as research and development.

Esteban joined CWP in Fall 2011. During his time at CWP, he has worked on migration velocity analysis using two-way operators. He has completed two internships, one each with BP and Total. Both internships focused on full waveform inversion (FWI) projects.

Outside of geophysics, Esteban enjoys playing volleyball, tennis, soccer, skiing and exploring Colorado and neighboring States.

Research
Esteban's main research interest is migration velocity analysis (MVA). At CWP, he studies the kinematic information contained in surface seismic data and seismic images. Esteban looks into different misfit errors measures, in both image and data domain, that improve the robustness of tomographic operators. His objective is to close the gap between high and low resolution tomographic methods.

Yuting DUAN
Degree Program: PhD, Geophysics
Country: China

Yuting received her Bachelor of Science and Master of Science degrees in 2010 and 2012, respectively, from the School of Earth and Space Sciences at Peking University in Peking, China. Her Master's thesis was titled, "ADPI elastic wave forward modeling based on high performance computing." She is currently working with Prof. Paul Sava, her CWP advisor. Yuting has worked on elastic migration and elastic wavefield tomography. She has interned twice with Shell in Houston, TX.

The first internship focused on marine imaging, followed by the second one focusing on 4D seismic interpretation.

Yuting loves to take part in a variety of activities; her favorites being swimming and traveling.

Research
Yuting's research is focused primarily on elastic imaging and elastic wavefield tomography. She is interested in developing elastic imaging conditions for converted waves, and currently she is working on elastic wavefield tomography to invert for P-wave and S-wave velocity models subject to constraints on the Vp/Vs ratio.
Chris GRAZIANO

Degree Program: MS, Geophysics
Country: USA

Chris graduated from the Colorado School of Mines with a Bachelor’s degree in geophysics and a minor in geology. During this time, he interned with Transform Software/DrillingInfo, where he worked with the support staff and programmed with the development team. He has also interned with Sigma Cubed, which gave him the opportunity to analyze and interpret a channel sands reservoir and propose new locations to drill. During the summer of his first year as a graduate student, Chris was fortunate enough to be able to participate in an internship with ExxonMobil, where he worked with their 4D seismic group to evaluate a new method to increase the repeatability between all time-steps in a 4D seismic project. This past summer, Chris interned with Denbury Resources. At Denbury he was able to work with geologists and reservoir engineers to solve daily problems that occurred during the tertiary recovery phase of the Bell Creek oil field. During his time at Denbury, Chris processed data, implemented code to attenuate noise, and interpreted PP and PS seismic volumes and well logs.

Chris joined CWP in Fall 2013 to work with Prof. Dave Hale. During his free time, Chris carves wood caricatures by hand, builds potato cannons, and loves to workout.

Research
Chris is currently working with Dr. Hale on a method to warp a PS image to a PP image without distorting the wavelet in the PS image. This warping-with-wavelets method involves convolving the PS image with a filter before and after warping. Ideally, the estimated filters used in the warping-with-wavelets method are the PP wavelet and the inverse PS wavelet. Chris's research and work interests are signal processing, formation evaluation, time lapse seismic, and geology.

Oscar JARILLO MICHEL

Degree Program: PhD, Geophysics
Country: Mexico

Oscar graduated from Instituto Politécnico Nacional, México, in 2010 with a Bachelor of Science degree in geophysical engineering. Shortly after, in Fall 2011, he joined the Center for Wave Phenomena. In 2015, he obtained a Master of Science degree in geophysics from the Colorado School of Mines, after which he continued into his PhD program at CWP.

Oscar is currently working on FWI for VTI media to estimate source and anisotropy parameters from microseismic data. His CWP advisor is Prof. Ilya Tsvankin.

Research
Oscar uses full-waveform modeling for dislocation-type sources to simulate microseismic events and implements the adjoint-state method to calculate the gradient required by full-waveform inversion (FWI) to estimate source location, source mechanism and velocity parameters in VTI media.
CWP Students

Xueyi (Alex) JIA
Degree Program: PhD, Geophysics  
Country: China

Xueyi graduated from Peking University with a Bachelor's degree in physics. He then pursued his Master's degree in geophysics at the University of Houston. His past research focused on shear wave characteristics of fluid saturated reservoir sandstones, three-component VSP seismic imaging, and geodetic co-seismic ground deformation analysis. His current research interests are fracture mechanics and seismic imaging. Xueyi joined CWP in August 2015 and is working with Prof. Roel Snieder.

Xueyi enjoys playing basketball, hiking, and cooking.

Alicia JOHNSON
Degree Program: BS, Geophysical Engineering  
Country: USA

Alicia is currently an undergraduate student at the Colorado School of Mines working towards her Bachelor's degree in Geophysical Engineering. Her expected graduation date is May 2016.

In April 2015, Alicia began conducting undergraduate research under the supervision of Prof. Paul Sava. Her research projects encompass seismic data processing and real-time GPR data processing.
Nishant KAMATH
Degree Program: PhD, Geophysics
Country: India

Nishant received his Bachelor's and Master of Science degrees in geophysics at the Indian Institute of Technology-Kharagpur in 2008. He worked as an On Board Processor for Schlumberger for two years before starting graduate studies at CSM with a minor in mathematics. He is currently working on Full-waveform Inversion (FWI) for 2D (elastic) VTI media to estimate vertical velocities and anisotropy parameters. Nishant interned with Shell International Exploration and Production, in Houston, Texas, in the summer of 2012. The work involved testing various parameters for serial- and joint-inversion (FWI) of acoustic (OBN) data and analysing the tradeoff between inversion parameters. In the summer of 2014, he interned with BP and worked on FWI testing for different model parameterizations on synthetic and real data. His advisor is Prof. Ilya Tsvankin.

Nishant's hobbies are hiking, reading, playing tennis and experimenting in the kitchen.

Research
Nishant is working on Full-waveform Inversion (FWI) to estimate Thomsen parameters (vertical P- and S-wave velocities, epsilon and delta) in 2D VTI media. One of the ways of understanding the trade-offs seen in the inversion results is by obtaining the 'radiation pattern' for a given parameterization. The insight gained from this can be used to choose an appropriate parameterization when inverting for a complex model. He is currently working on a 2D synthetic model based on the geology of the Valhall field.

Vladimir LI
Degree Program: PhD, Geophysics
Country: Russia

Vladimir received his Bachelor of Science and Master of Science degrees in geophysics from Lomonosov Moscow State University (LMSU). During his studies, he worked in the Shallow Seismic Group at the Department of Seisimcs and Geoacoustics, acquiring and processing shallow seismic data. As an undergraduate student at LMSU, he received the ConocoPhillips Excellence in Education Award for the 2007-2008 academic year. He joined CWP in August 2012 and his advisor is Prof. Ilya Tsvankin.

Vladimir enjoys playing tennis, hiking, and reading. Vladimir was the former Moscow State University student chess champion.

Research
Vladimir is currently working on wavefield tomography using extended images in "acoustic" tilted TI media. Imaging with inaccurate anisotropy parameters causes the residual energy appearing at nonzero correlation lags, which can be used to update the velocity model.
Ivan Chen Ning LIM
Degree Program: PhD, Geophysics
Country: Malaysia

Ivan graduated in 2012 from Multimedia University, Malaysia, with a Bachelor of Engineering with Honors in electronics. At graduation, he received the President’s award for his academic and co-curricular achievements. Ivan continued his studies in the Royal School of Mines at Imperial College London, where he received his Master’s degree with Distinction, in petroleum geophysics. During his studies at Imperial College, Ivan did an internship at CGG United Kingdom, where he worked on 4D seismic data processing using conventional towed streamer and ocean bottom nodes data. Following his graduation from Imperial College, Ivan worked for a year as a geophysicist at CGG UK, processing data from the North Sea and Barents Sea.

Ivan joined CWP in Summer 2015 to work with Prof. Paul Sava, his advisor. In his free time, Ivan enjoys swimming, badminton and traveling.

Qifan LIU
Degree Program: PhD, Geophysics
Country: China

Qifan graduated from Texas A&M University in 2015 with a Bachelor of Science in geophysics and a minor in mathematics. During his undergraduate studies, Qifan started research on seismic anisotropy in microseismic data.

He joined CWP in August 2015 under the supervision of Prof. Ilya Tsvankin. In his spare time, Qifan enjoys a variety of sports, including cycling and soccer.
Sonali PATTNAIK
Degree Program: PhD, Geophysics
Country: India

Sonali received her Bachelor’s and Master of Science degrees in exploration geophysics at the Indian Institute of Technology, Kharagpur in 2014. Her Master’s thesis focused on various numerical techniques to model the acoustic wavefield in layered media. During her studies at IIT, Sonali interned at the National Institute of Oceanography in Goa, where she worked on 3D seismic data processing using ProMAX 2D/3D and adopted a specially designed processing sequence for gas hydrate studies. Sonali also interned at BG Exploration and Production India, where she developed an integrated interpretation of seismic, well log and gravity data to study the sub-basalt section. She independently developed a Petrel Plugin using Ocean SDK for quick evaluation of gravity data. Sonali’s CWP advisor is Prof. Ilya Tsvankin. Her research interests are seismic anisotropy, inversion and seismic imaging.

Sonali enjoys playing badminton, reading novels and travelling.

Aaron PRUNTY
Degree Program: PhD, Geophysics
Country: USA

Aaron graduated from Virginia Polytechnic Institute and State University in 2013 with a Bachelor of Science degree in geosciences. While an undergraduate, he had a summer internship with the Incorporated Research Institutions for Seismology (IRIS) Consortium, where he performed shear-wave splitting analysis of aftershocks to determine variations in the local stress field. Also while an undergraduate and during the year after his graduation, Aaron worked as a research assistant in the Department of Geosciences at Virginia Tech on high performance mantle convection modeling aiming to understand catastrophic resurfacing mechanisms for the planet Venus.

Aaron joined CWP in Summer 2015 to work with his advisor, Prof. Roel Snieder. Aside from academic research, Aaron enjoys playing soccer, swimming, hiking, snowboarding, and eating good food.

Research
Aaron’s current research interests are in wave propagation and imaging in strongly-scattering media.
**Thomas RAPSTINE**

Degree Program: PhD, Geophysics  
Country: USA

Thomas graduated with a Bachelor of Science degree in geophysics from the Colorado School of Mines in 2013. He completed his Master’s degree in geophysics at CSM in Fall 2015 in the Center for Gravity, Electrical, and Magnetic studies (CGEM). His master’s thesis focused on using spatially guided fuzzy c-means clustering inversion to integrate gravity gradiometry data and seismic interpretations. Thomas joined CWP in the fall of 2015 under the guidance of his advisor, Prof. Paul Sava. The past three summers Thomas has been a teaching assistant at the Colorado School of Mines field camp helping conduct geophysical surveys to characterize geothermal systems around Pagosa Springs, CO. In the summer of 2013, Thomas was an intern in the Applied Reservoir Management (ARM) team at Chevron interpreting seismic data, seismic attributes, and well log data to characterize unconventional reservoirs. At his last internship in the summer of 2014 at Chevron, Thomas was a member of the Gravity Electrical and Magnetics group in the Chevron Energy Technology Company (ETC) and helped develop depth to base of magnetic source maps using magnetic and gravity data in order to aid basin modeling.

Thomas enjoys painting, running, inversion, billiards, integrated geophysics, and road tripping.

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**Daniel ROCHA, Jr.**

Degree Program: PhD, Geophysics  
Country: Brazil

Daniel graduated in 2013 from the Universidade Federal da Bahia (UFBA) in Brazil. He spent a portion of 2012 on an exchange program at the Colorado School of Mines, where he took two semesters of classes and spent his summer at the Center for Rock Abuse in the Department of Geophysics. At UFBA, Daniel's research centered on deconvolution and ground-roll filtering techniques. Later on, Daniel studied linear and non-linear inversion using gradient methods, which became the main subject of his BS thesis, titled "Inversion of interval velocities". Following his graduation from UFBA, Daniel worked for a year at Petroleum Geo-Services, where he focused on seismic processing, including: noise filtering, multiple attenuation, data regularization, and time migration. Daniel's CWP advisor is Prof. Paul Sava.

Outside of geophysics, he enjoys the outdoors (soccer and snowboarding), playing the guitar and chess.

**Research**

Daniel is currently working on wavefield imaging using the energy norm, whose main practical advantage is to create images with attenuated artifacts for various types of wavefields (acoustic, elastic, etc).
Hui WANG
Degree Program: PhD, Geophysics
Country: China

Hui graduated from Zhejiang University with a Bachelor's degree in earth science. Following his graduation, he studied at King Abdullah University of Science and Technology (KAUST) in Saudi Arabia, where he received his Master's degree in geophysics. During his time at KAUST, Hui worked on depth migration, using the so-called prestack exploding reflector model to do two-way migration and modeling. His research also included exploring the efficiency gain for large-scale computations and he has experience working with some cutting-edge clusters and supercomputers. Hui joined CWP in August 2014. His CWP advisor is Prof. Ilya Tsvankin, and his main research interests are seismic inverse problems and computational mathematics.

Apart from geophysics, Hui enjoys scientific reading, programming, and sports with friends and family.

Satyan SINGH
Degree Program: PhD, Geophysics
Country: Trinidad and Tobago

Satyan graduated from the University of West Indies in 2008, with a Bachelor of Science degree in petroleum geosciences. While an undergraduate, he had a summer internship with BP Trinidad and Tobago, which was followed by his employment as an exploration geophysicist at BG Group Trinidad and Tobago. After one year of employment in the oil and gas industry, he decided to pursue a Master of Science degree in geophysics at Texas A&M University. Satyan joined CWP in August 2011 and his advisor is Prof. Roel Snieder. His current interest is retrieving the Green's function and imaging.

Apart from academic research, Satyan enjoys playing table tennis, cricket and football.

Research
Satyan's current research is retrieving the Green's function in the presence of the free surface. Satyan presents a new scheme that focuses primaries and all multiples, i.e., internal multiples and free surface multiples. In other words, we retrieve the Green's function in the presence of the free surface. Our requirements are still the reflection response and an estimate of the first arrival at the surface from the virtual source. Significantly, the reflection response includes the free surface multiples, i.e., no free surface multiple removal is required.
Xinming WU

Degree Program: PhD, Geophysics  
Country: China

Xinming received a Bachelor of Engineering degree in 2009 in geophysics from Central South University, Changsha, China. He earned a Master of Science degree in 2012 in geophysics from Tongji University, Shanghai, China. Xinming joined CWP in August 2012 and is working with Dr. Dave Hale. He interned twice at Drillinginfo in Littleton, Colorado. From August 2015, he will be working with Dr. Sergey Fomel as a visiting scholar at the University of Texas, Austin.

Xinming enjoys reading, watching movies, cooking, traveling and staying with family.

Research
Xinming is mainly interested in 3D seismic image processing for interpretation. He has worked on fault processing for fault surface extraction, fault slip estimation, and seismic image unfaulting; unconformity processing for unconformity surface extraction and seismic normal vector estimation at unconformities; image flattening with or without control points. He is now working on structure- and stratigraphic feature-guided interpolation and simultaneous multiple-well ties.

CWP Long-Term Visitors

Tariq ALKHALIFAH

Tariq A. Alkhalifah is a professor of geophysics in the division of Physical Sciences and Engineering at at King Abdullah University for Science and Technology (KAUST). He assumed his duties there in June 2009. Prior to joining KAUST, Tariq was a research professor and director of the Oil and Gas Research Institute at King Abdulaziz City for Science & Technology (KACST). He has also been associate research professor, assistant research professor and research assistant at KACST. From 1996 to 1998, Tariq served as a postdoctoral researcher for the Stanford Exploration Project at Stanford University, USA. He received the J. Clarence Karcher Award from the Society of Exploration Geophysicists (SEG) in 1998 and the Conrad Schlumberger Award from the European Association for Geoscientists and Engineers (EAGE) in 2003. Prof. Alkhalifah is a member of SEG and EAGE. Tariq received his doctoral degree in geophysics (1997) and master’s degree (1993) in geophysical engineering from the Colorado School of Mines, USA. He holds a bachelor’s degree (1988) in geophysics from King Fahd University of Petroleum and Minerals, Saudi Arabia.

Research
Tariq's research interests are in full waveform inversion, imaging and velocity model building for exploration seismic data with special emphasis on media that exhibit anisotropic behavior of wave propagation. He is also interested in seismic acquisition and processing of near surface data for better near surface treatment.
Guillaume CAUMON

Guillaume Caumon is the Nancy School of Geology Professor in Geomodeling at Université de Lorraine, where he teaches 3D modeling, programming, geostatistics and field classes. Guillaume is doing research at GeoRessources on 3D subsurface modeling methods to integrate subsurface data and geological knowledge while accounting for uncertainties. Since 2007, Prof. Caumon has been directing the Gocad Research Consortium, which received the Significant Achievement Award from the Society of Exploration Geophysicists in 2009. He also received the Vistelius Award from the International Association of Mathematical Geosciences in 2009 and served as Deputy Editor for the journal Mathematical Geosciences in 2012-2014. At CWP, Prof. Caumon is working with Prof. Dave Hale and CWP student Xinming Wu on well correlation and seismic-to-well ties.

Research

Prof. Caumon's research interests include: numerical modeling, processing and visualization of geological objects and inverse problems.

Nabil MASMOUDI

Nabil is a PhD student at King Abdullah University for Science and Technology (KAUST) in Saudi Arabia. He works with Prof. Tariq Alkhalifah. Nabil received a Polytechnic Engineer degree from Tunisia Polytechnic School in 2012, and received a Master's degree in geophysics from KAUST in 2014. For four months in 2012, Nabil interned with the OPERA Applied Geophysical Research Group, in France, and he worked closely with Dr. Evgeny Landa on path-integral seismic imaging. In 2013, he collaborated with Prof. Ivan Psencik on ray tracing during his visit to the Institute of Geophysics, in the Czech Republic. In 2014, Nabil worked on anisotropy estimation with Prof. Alexey Stovas during his visit to Norwegian University of Science and Technology (NTNU) in Norway. Nabil's research interests are in seismic modeling, imaging and inversion in anisotropic media. He is developing optimal strategies for multi-parameter inversion in complex structures. Nabil is also interested in ray theory and partial differential equations. He is a member of the SEG and EAGE. Apart from academic research, Nabil enjoys traveling and sports.

Thomas PLANÈS

Thomas joined CWP in September 2015 to work with Prof. Roel Snieder on the seismic imaging of the Earth's crust using migration of surface waves. Prior to that, he worked as a postdoctoral researcher in Prof. Michael Mooney's team, in the Department of Civil Engineering at the Colorado School of Mines. His main project was monitoring earthen embankments using passive seismic methods. Thomas received his PhD in geophysics in 2013 from the University of Grenoble. His PhD studies focused on imaging in strongly scattering media at the Institute for Earth Sciences (IISTerre), under the supervision of Eric Larose. He holds an MS in physics from the University of Toulouse, France.

Research

Thomas' research interests lie in the fields of wave propagation and imaging in complex media. He works on active and passive imaging techniques at different scales and across various disciplines, such as non-destructive evaluation of materials, time lapse monitoring of civil structures and geophysical objects.
Zedong WU

Zedong graduated from Sichuan University with a Bachelor's degree in mathematics. Under the guidance of his advisor Prof. Zhiming Chen, Zedong received his PhD degree from the Institute of Computational Mathematics and Scientific/Engineering Computing at the Chinese Academy of Sciences (CAS). After graduation, Dr. Wu worked as an assistant professor at the Institute of Computing Technology in CAS. He then joined the King Abdullah University of Science and Technology (KAUST) in Saudi Arabia as a post-doctoral student under Prof. Tariq Alkhalifah.

Research
Dr. Wu’s research interests include: Full waveform inversion, spectral method, prestack wavefield extrapolation, high performance computing and finite element method.