Dr. Andrey Bakulin (<u>pdf version</u>)

Bureau of Economic Geology
The University of Texas at Austin
P.O. Box X
Austin, Texas 78713-8924

E-mail: andrey.bakulin@beg.utexas.edu
Telephone: 512-232-9464

HONORS/AWARDS

2023 SEG Reginald Fessenden Award, Society of Exploration Geophysics for "substantial contributions to interferometry theory, imaging, and monitoring with virtual sources below a complex near surface which have impacted many processing and acquisition applications."

Honorable Mention in the category Best Paper in GEOPHYSICS, 2022 from the Society of Exploration Geophysics for "<u>Multiplicative seismic noise caused by small-scale near-surface scattering and its transformation during stacking</u>"

2022 SEG Middle East Presentation Award, recognizing the exceptional contributions made to the SEG and the region during 2012-2022

2021 World Oil finalist for Best Exploration Award, for "Multi-purpose use of near-bit vibration tool: from better seismic-while drilling to optimized drilling to synthetics logs"

2020 SEG Top 25 Presentations, for the paper <u>"Seismic data enhancement and targeted noise removal using time-frequency masking guided by beamformed data"</u>

2019 EAGE Conrad Schlumberger Award, European Association of Geoscientists & Engineers (2019) to "an outstanding geophysicist who has worked in many areas of geophysics and has been especially concerned with solving problems that impact data quality and efficiency"

2017 SEG Top 39 Presentation, for the paper "<u>Enhance—estimate—image: New processing approach for single-sensor and other seismic data with low prestack signal-to-noise ratio</u>"

Innovation Award from the 2017 International Conference of Engineering Geophysics, for paper "<u>Smart DAS upholes for near surface model building and deep imaging with vertical arrays </u>"

2013 Distinguished Achievement Award to Saudi Aramco EXPEC ARC Geophysics Technology, the highest Society of Exploration Geophysics award to an institution for a technical contribution to <u>exploration geophysics</u>.

2011 SEG Distinguished Lecturer, Virtual source method for imaging and monitoring below complex overburden

Honorable Mention in the category of Best Paper Presented at the Society of Exploration Geophysicists 2009 Annual Meeting, for the paper "<u>Building TTI depth models using anisotropic tomography with well information</u>"

Best Paper Presented at 2008 meeting of the Society of Exploration Geophysicists, for the paper "<u>Estimating interval shear-wave splitting from multicomponent virtual shear checkshots</u>"

Honorable Mention in the category Best Paper in GEOPHYSICS, 2008 from Society of Exploration Geophysics for "Real-time completion monitoring with acoustic waves"

2007 E&P Special Meritorious Awards for Engineering Innovation, the prestigious Hart E&P award was given to Virtual Source technology that I pioneered and developed at Shell with R. Calvert.

Best Paper Presented at 2006 meeting of Society of Exploration Geophysicists, for the paper "Virtual Shear Check- shot with airguns".

Honorable Mention in the category Best Paper in GEOPHYSICS, 2006 from the Society of Exploration Geophysics for the paper "Virtual Source Method: Theory and case study".

J. Clarence Karcher Award, Society of Exploration Geophysics (2005) in "recognition of your contributions in the areas of imaging scattering series, time-lapse seismic monitoring, inversion and processing on anisotropic media, rock physics and fracture characterization"

EDUCATION

ST.PETERSBURG STATE UNIVERSITY, B.S., M.S. (*cum laude*) and Ph.D. in Geophysics
Ph.D. thesis title: "Features of seismic wave propagation in effective models of fractured and porous rock"

MAJOR PROFESSIONAL EXPERIENCE AND KEY CONTRIBUTIONS

Research Professor
BUREAU OF ECONOMIC GEOLOGY, UT Austin   2023-PRESENT

Senior Geophysical Consultant
SAUDI ARAMCO, EXPEC Advanced Research Center   2010-2023
Novel prestack processing of challenging land data in a desert environment (key paper)
- Invented speckle noise model describing near-surface scattering that distorts reflections. This discovery paves the way to make single-sensor seismic work in the desert environment
- Pioneered a new decluttering approach Seismic Time-Frequency Masking, that preserves higher frequencies
- Developed nonlinear beamforming for data with a low signal-to-noise ratio
- Developed flexible supergrouping for efficient processing of high-channel count and single-sensor data
- Pioneered Adaptive Multiscale Processing using fit-for-purpose enhancement for each frequency band
- Pioneered statistical depth imaging for areas with complex near surface
- Proposed new processing approach Enhance – Estimate – Image (E^2I) for challenging data

3D seismic acquisition design and volumetric QC for challenging land data (key paper)
- Developed effective methods to evaluate prestack signal-to-noise ratio applicable to -30 to -60 dB representative of small arrays and single-sensor data in desert environments *(key paper)*
- Developed automated numerical workflow for survey design evaluation free of human bias that closes the loop between acquisition and processing and enables effective decision-making *(key paper)*
- Numerically validated industry-standard Signal-Strength Estimate used in the 3D survey design *(key paper)*

Novel applications of DAS for land exploration and monitoring (key paper)
- Developed an efficient acquisition method for Smart DAS upholes using high-productivity drilling with dual rotary and novel fiber cable deployment *(key paper)*
- Piloted Near Surface Crew with HD weathering surveys required for the desert environment *(key paper)*
- Invented seismic acquisition with vertical DAS arrays (aka Smart DAS acquisition system) and benchmarked to surface seismic with geophones *(key paper)*
- Proposed surface seismic with DAS *(key paper)*
- Invented smart DAS upholes *(key paper)*

Seismic-while-drilling (SWD) and synthetic logs with DrillCAM in a desert environment (key paper)
- Demonstrated near-surface and overburden characterization using 3D seismic-while-drilling with downhole near-bit pilot sensor *(key paper)*

- Proven improved SWD quality with a downhole pilot in a desert environment *(key paper)*
- Proven temporal convolutional network for generating synthetic logs from drilling parameters *(key paper)*
- ML method for predicting sonic logs based on drilling parameters and downhole vibrations *(key paper)*
- Demonstrated value of near-bit vibrations for synthetic logs in horizontal wells *(key paper)*

Permanent monitoring of carbonate reservoirs in a desert environment with buried sensors
- Developed a novel permanent land system with buried receivers and dense vibroseis sources *(key paper)*
- Repeatability of 4 % NRMS achieved over more than a year (dry-to-dry season) *(key paper)*
- Proven successful monitoring of land carbonate reservoirs

Principal Research Geophysicist
SCHLUMBERGER/WESTERNGECO, HOUSTON, TEXAS   2008-2010
Anisotropic velocity model building (key paper)
- Developed interactive anisotropic tomography with well constraints (checkshots, markers, walkaway VSP) for *TTI* media *(key paper)*
- Developed interactive anisotropic tomography with well constraints (checkshots, markers, walkaway VSP) for *VTI* media *(key paper)*
- Application of steering filters to localized anisotropic tomography with well data *(key paper)*

3D geomechanics for velocity model building (key paper)
- How to use 3D stress field to update anisotropic velocity filed around and below salt bodies

Research Geophysicist
SHELL E & P, BELLAIRE TECHNOLOGY CENTER, HOUSTON, TEXAS   2001-2008
Virtual Source Method (key paper)
- Pioneered and developed a new method of downhole imaging using time reversal that allows seeing targets through an overburden of any complexity without knowledge of the overburden velocity model
- Invented and implemented Virtual Shear Sources and applied them to deepwater sub-salt velocity estimation
- Developed super-sensitive Virtual Source monitoring for reservoirs below complex time-variant near-surface

Seismic anisotropy and stresses (key paper)
- Developed a method to separate and differentiate layer-induced and intrinsic shale anisotropy
- Developed simplified upscaling methods for anisotropic formations
- Showed that Vp/Vs ratio can be used as an indicator of anomalous stress regimes in mudrocks
- Developed methods to predict velocity and anisotropy anomalies caused by spatial or temporal anomalies in 3D stresses and successfully explained log and seismic anomalies in complex geologies

Real-time completion monitoring of deepwater wells with acoustic waves (key paper)
- Developed a new method of in-well real-time completion monitoring with tube waves
- Developed prototype fiber-optic acoustic system for in-well acoustic monitoring
- Developed a cost-effective method of tube-wave monitoring of oil fields and gas hydrates

Senior Research Scientist
SCHLUMBERGER CAMBRIDGE RESEARCH, CAMBRIDGE, UK   1999-2001 (3 years)
Pore pressure and 3D stress characterization and monitoring based on anisotropic velocity model (key paper)
- Developed theory, methodology, and workflow for borehole-calibrated estimation of 3D stress field based on joint use of multicomponent seismic and advanced acoustic logging
- Initiated, conducted, and analyzed lab experiments proving the concept of 3D stress estimation from seismic

Fracture characterization and seismic anisotropy (key paper)
- Developed anisotropy estimation and fracture-characterization methods using VSP and multicomponent seismic
- Tested methodology on field example of multi-azimuth VSP from Middle East and North Sea seismic

Integration of fluid flow modeling into interpretation of time-lapse seismic response (key paper)
- Created a concept and implemented a prototype for 4D closing the loop: computing synthetic 4D seismic from the Eclipse fluid-flow model. Successfully tested the approach on data from the Foinaven field

Visiting Scientist
CENTER FOR WAVE PHENOMENA, COLORADO SCHOOL OF MINES   1998 (3 month)
- Developed systematic and quantitative rock-physics based approach to the problem of estimation of fracture parameters from different types of seismic data (HTI paper, ORT paper, monoclinic paper)

Assistant Professor (since 1997). Lecturer (until 1996)
DEPARTMENT OF GEOPHYSICS, ST.PETERSBURG STATE UNIVERSITY, RUSSIA   1995-1999
Teaching
- Taught "Seismic prospecting" and "Theory of the Earth" to undergraduate students and "Seismic Migration" to graduate students
- Supervised 20 students in their research and field practice

Research
- Construction of effective models of anisotropic porous and fractured media. Study of anisotropic wave propagation in porous and fractured media based on effective and Biot models

PUBLICATIONS AND GENERAL SCIENTIFIC INTERESTS *(pdf list)*
My industry papers are some of the most highly cited in exploration geophysics (*h*-index of 32). Author of two books and more than 270 publications devoted to seismic imaging, borehole geophysics, and rock physics. Author of many patents on novel seismic imaging and monitoring methods. My current research interests include acquiring and processing land seismic data, doing reservoir geophysics with land data, permanent monitoring of land carbonate reservoirs, and novel applications of DAS to land exploration and monitoring.

PROFESSIONAL MEMBERSHIPS
Society of Exploration Geophysics, European Association of Geoscientists and Engineers, Society of Petroleum Engineers, Acoustical Society of America, American Geophysical Union, Houston Geophysical Society

PROFESSIONAL ACTIVITIES
EAGE Awards Committee member since 2019
Associate Editor of Geophysics (2004-2014)
SEG Distinguished Lecturer (2011)
Chair and member of the organizing committee for many SEG and EAGE workshops
Chair of technical sessions at international EAGE, SEG, and AAPG meetings
SEG regional coordinator for the Former Soviet Union (2006-2014)
Reviewed articles for Geophysics, Geophysical Prospecting, Journal of Geophysical Research, Journal of Acoustical Society
Gave numerous invited talks at companies, universities, and meetings of professional societies
Grant and contract proposal reviewer for DOE