

ISSUE

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# BIANNUAL NEWSLETTER



## IN THIS ISSUE

**P.2**

Consortium introduction

**P.3**

Research focus

**P.4**

The team

**P.5**

News



## We have launched DeepWave

The consortium will be holding its first meeting on December 13-14, 2022. During this meeting participants will have the chance to familiarize with the current research topics that our scientists and students are working on.

This meeting will mark the beginning of a lasting collaboration between academia researchers and our industry partners. We aim to start a fruitful dialogue that will eventually lead to exciting scientific breakthroughs.

Join us in this journey of knowledge and exploration as a sponsor!

Find more about our consortium by either contacting us via e-mail [[deepwave@kaust.edu.sa](mailto:deepwave@kaust.edu.sa)] or by visiting the DeepWave website [[deepwave.kaust.edu.sa](http://deepwave.kaust.edu.sa)].

DeepWave is an industry funded research consortium at King Abdullah University of Science and Technology (KAUST), which focuses on the application of machine (deep) learning numerical algorithms to wave-equation-based processing, imaging, and inversion.

The application of these techniques extends to objectives ranging from global Earth discovery, to natural resources exploration, to subsurface monitoring as well as non-destructive testing and medical imaging.

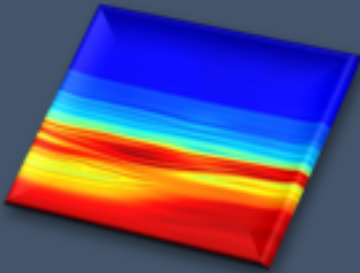
### Goal

To be a leading center for the research and development of machine learning algorithms on waveform data with applications ranging from the exploration and discovery of the Earth to reservoir characterization and monitoring for oil and gas, geothermal, and CO<sub>2</sub> storage purposes.

### Mission

To foster an environment of effective research for the students and researchers that promotes seamless interaction with our sponsors.

# DeepWave Research

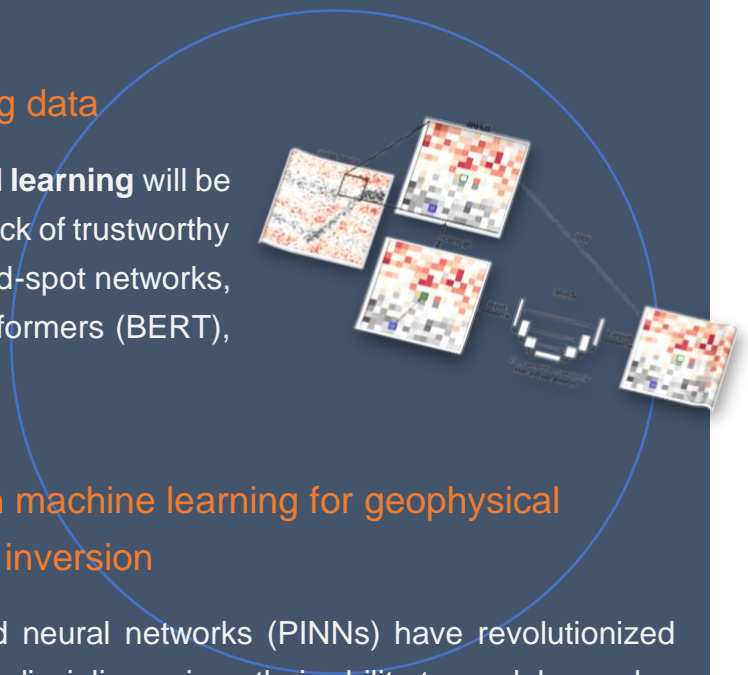


## ML-assisted subsurface characterization and monitoring

Complement classical inversion algorithms with machine learning to bridge the **resolution** gap between well information and seismic data, inverting complex **non-linear relationships** (e.g., rock physics models), and providing informative priors towards robust **uncertainty quantification**.

## Closing the gap between training and testing data

Novel developments in the area of **self-supervised learning** will be exploited to mitigate the challenges related to the lack of trustworthy labelled data. This includes, but it is not limited blind-spot networks, Bidirectional Encoder Representations from Transformers (BERT), representation and contrastive learning.



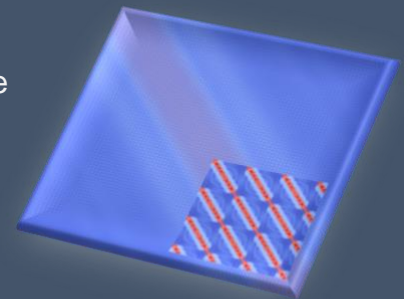
## Physics-driven machine learning for geophysical modelling and inversion

Physics-informed neural networks (PINNs) have revolutionized several scientific disciplines given their ability to model complex physical processes. We plan to develop the next-generation of modelling tools as well as to exploit the properties of PINNs for seismic processing tasks that can be explained by an underlying **partial-differential equation**.



## By-products of the AI revolution

The AI revolution has taken the entire scientific community by storm. We plan to exploit algorithmic improvements in **stochastic optimization** as well as **hardware** and **software** advances in low (and mixed) precision floating-point arithmetic for geophysical applications.





**Claire Birnie** | *Research Scientist*

**Shijun Cheng** | *Postdoctoral Fellow*



**Nick Luiken** | *Postdoctoral Fellow*

**Fu Wang** | *Postdoctoral Fellow*



**Christos Tzivanakis** | *Research Specialist*

**Abdullah AlAli** | *PhD Student*



**Mustafa Alfarhan** | *PhD Student*

**Francesco Brandolin** | *PhD Student*



**Miguel Corrales** | *PhD Student*

**Mohammad Randy Caesario Harsuko** | *PhD Student*



**Xinquan Huang** | *PhD Student*

**Muhammad Izzatullah** | *PhD Student*



**Sixiu Liu** | *PhD Student*

**Mohammad Hasyim Taufik** | *PhD Student*



**Yuanyuan Yang** | *PhD Student*

**Isa Eren Yildirim** | *PhD Student*



**Ning Wang** | *PhD Student*

**Hussain Alfayez** | *MSc Student*



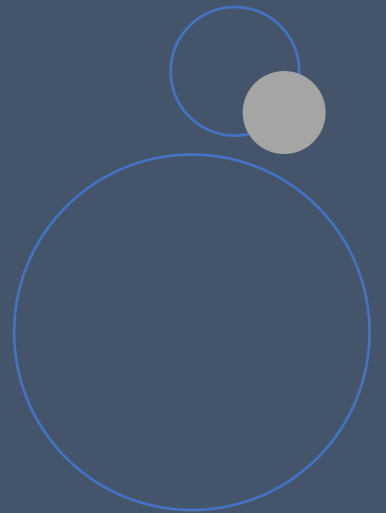
**Juan Romero Murcia** | *MSc Student*

**Danilo Chamorro Riascos** | *MSc Student*



## The Team

A team of researchers and students with diverse background and broad technical expertise working together on DeepWave's research topics.



## News

- **KAUST's AI initiatives showcased at the 2022 Global AI Summit**

KAUST joined AI innovators, industry and government leaders, policy makers and collaborators from around the world at the [2022 Global Artificial Intelligence \(AI\) Summit](#) in Riyadh, Sept 13–15.

- **Matteo Ravasi receives the EAGE Arie van Weelden Award 2022**

The award is presented to an EAGE member - a geoscientist or engineer aged 35 or below at the time of their nomination - who has made a highly significant contribution to one or more of the Association's disciplines. Alongside his scientific contributions, Matteo was also a member of the EAGE Young Professional Committee for several years and helped the Association increase its engagement with other early-career scientists.

- **Keynote speaker at SEG Workshops**

Tariq Alkhalifah presented a keynote presentation titled "StorSeismic: Seismic processing "dataset-centric" deep learning framework based on pre-training" in the *Artificial Intelligence For Subsurface Characterization: Advances, Pitfalls, and Limitations* that was held in Kuala Lumpur (Malaysia) Sept. 20-21, 2022. Following this, Tariq participated in the Near-Surface Modeling and Imaging Workshop in Muscat (Oman) Sept. 27-29, 2022, where he delivered a keynote presentation on "Neural network solutions to complex near-surface inversion problems".

- **SEG | DGS Middle East Challenge Bowl Competition 2022**

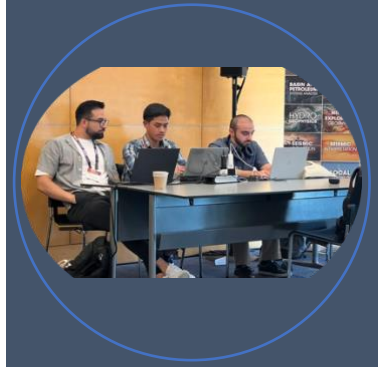
KAUST team (Gaurav Siddharth Gairola and **Mustafa Alfarhan**) participated in the SEG Middle East Challenge Bowl Competition where teams of students battle it out for the title of regional winner in the field of geoscience. The team came back with the First Place and will represent the region in the virtual Global Challenge Bowl Finals taking place on 22 October.

## Scope of research

The Consortium aims to deliver the most effective solutions to waveform processing, imaging, and inversion challenges across multiple scales.

- **EAGE 2022 - Hackathon on Explainable AI**

A team of KAUST students (**Abdullah Alali, Miguel Angel Corrales Guerrero, Randy Harsuko, and Danilo Chamorro Riascos**) won the [first EAGE Hackathon on Explainable AI](#) (XAI) during EAGE 2022 Annual Meeting in Madrid.



- **8<sup>th</sup> KAUST – NVIDIA Hackathon**

A team of DeepWave researchers (**Juan Daniel Romero, Nick Luiken and Miguel Angel Corrales Guerrero**) was awarded the Best Performance achievement for accelerating their Primal-dual algorithm for image segmentation during the 8th KAUST-NVIDIA Hackathon. The team received an NVIDIA GPU RTX 3080Ti card for this feat. The event provides an opportunity for participants to learn about the latest advances by NVIDIA in Scientific Computing and Artificial Intelligence as well as showcasing the related KAUST success stories using GPUs.

- **DeepWave on Github**

The DeepWave [Github organization](#) has been created to provide seamless sharing of codes between the DeepWave students and researchers and the Consortium sponsors. All sponsors are encouraged to provide their GitHub username to be included in the organization.

**DeepWave Consortium | Issue 01 | Fall 2022**

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