Artificial Energy General Intelligence AEGI

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Abstract

Artificial Energy General Intelligence (AEGI) is a natural progression of Artificial General Intelligence (AGI) that caters to the energy industry. It is crucial to optimize the entire value chain involved in generating, transporting, and storing energy for the betterment of humanity, the environment, industry, and the scientific community. Most research efforts focus on a specific area of the value chain, leading to a disconnect between multiple disciplines and hindering effective problem-solving. AEGI proposes integrating the learning from each discipline in the energy sector to create an optimal solution that simultaneously addresses multiple objectives. This integration is more complex than solving each discipline's challenges separately, but achieving a sustainable and efficient energy system is necessary.

Introduction

We understand that each discipline needs to improve its problem-solving abilities in a more integrated way. This is because solving challenges at one stage of the energy value chain can create new challenges for the next stage. Therefore, we are building algorithms that will allow AEGI to understand objectives and challenges from data and recommend optimized solutions [1]. These solutions include going greener during energy generation across the whole value chain. Therefore, we include the environmental enhancement element in every decision optimization [2]. This work considers the oil and gas (O&G) value chain for AEGI, including an objective to become a cleaner energy production operation where integrated data is analyzed.

The optimum data integration across the O&G would be using the cloud [3]. However, the O&G data in many countries are rarely in the cloud unless the servers are in the country. In Fig. 1, the O&G value chain we use in this research shows the impact sequence of each of the seven stages with Artificial intelligence (AI) optimization: Geoscience [4-38], Reservoir [39-46], Completion [47], Drilling [48], Production, Network, and Facility. Where integrated optimization with AEGI provide high efficiency in term of time, cost [49], environment, and energy production. To build the AEGI, we capture the interconnectivity between each stage to establish a full coupling between the stages where the input of each stage is the output of the previous stage. Also, we consider feedback from each stage to the other to optimize backward. Therefore, the whole system appears like one extensive deep neural network that keeps optimizing itself to provide insight to the human user.

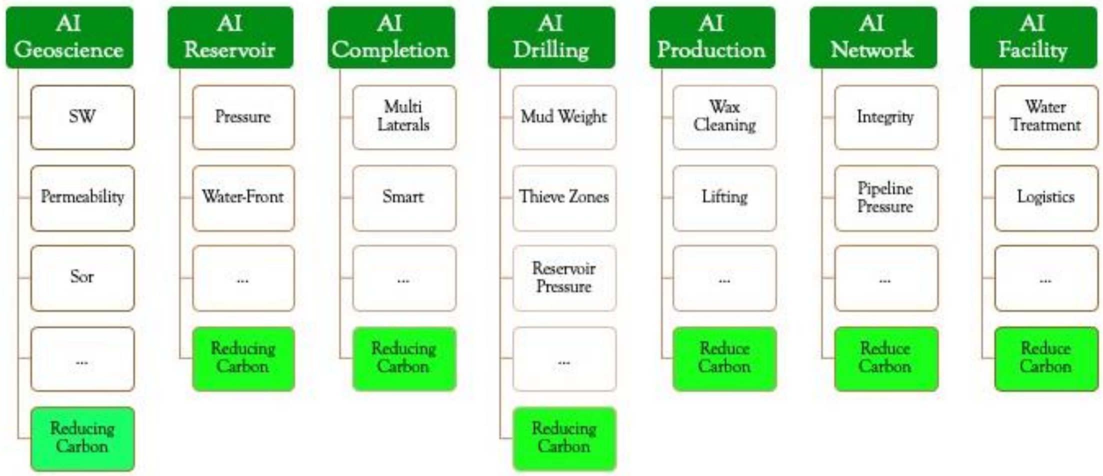

Fig. 1. O&G Value Chain with the AI Optimization at each Stage for AEGI.

Method

Keep the system life with continuous learning despite the data being a semi-live copy with a short delay for generating an offline copy to prevent damaging the original data. The learning that the machine acquire is part of the feature engineering and the feedback loop that the domain expert of each stage provides. This machine has an autonomous path to try other data that are not part of the channels provided by the domain expert. Also, the machine can establish feedback loops that are different from the ones established by the domain expert. Then every time the machine reaches a better optimization, a notification is set to the domain expert explaining the new added value generated by the new optimization. The machine would also be provided the freedom to link multistage to identify the root cause of some phenomena not generated from the prior stage but the one before or even before that. This understanding of the root cause and recommendation options provides new insights that the expert would have never been able to reach without this autonomous freedom given to the machine to explore.

References

[1] O. Alfarisi, Z. Aung, Q. Huang, A. Al-Khateeb, H. Alhashmi, M. Abdelsalam, S. Alzaabi, H. Alyazeedi, and A. Tzes, "3D Adapted Random Forest Vision (3DARFV) for Untangling Heterogeneous-Fabric Exceeding Deep Learning Semantic Segmentation Efficiency at the Utmost Accuracy," *arXiv preprint arXiv:2203.12469*, 2022.

[2] O. Alfarisi, *Hubnomics: Chapter 1-The World Biggest Challenges Solution*, Center for Open Science, 2022.

[3] O. Alfarisi, *Cloud Service Marketing Strategy Framework for Higher Value Customer-Segments Deployment*, Center for Open Science, 2023.

[4] A.-F. Omar, D. Nasser, B. Douglas, A.-F. Ali, and A.-K. Farouk, “Monitoring and controlling the quality of well log information,” *SPE,* vol. 87298, pp. 13-15, 2000.
[5] A. Al-Hendi, O. Al-Farisi, and M. Ouyiga, "Two Generations of Thermal Decay Tools," Abu Dhabi, 2004.
[6] G. Mercado, O. Al Farisi, and D. Boyd, "Large Hole LWD Compressional Sonic, New Age of High Quality Seismograms in Offshore Abu Dhabi, UAE."
[7] O. Al-Farisi, M. Elhami, A. Al-Felasi, F. Yammahi, and S. Ghedan, "Revelation of carbonate rock typing–the resolved gap."
[8] T. Weldu, S. Ghedan, and O. Al-Farisi, "Hybrid AI and conventional empirical model for improved prediction of log-derived permeability of heterogeneous carbonate reservoir."
[9] S. Ghedan, T. Weldu, and O. Al-Farisi, "Hybrid Permeability Prediction Model for Heterogeneous Carbonate Reservoirs with Tarmat Layers Considering Different Levels of Cutoffs."
[10] S. Khemissa, A. Al-Shemsi, S. Al-Felasi, O. Al-Farisi, S. Fathalla, R. Ghalem, T. Nakamura, and A. Al-Alyak, "Reservoir Characterisation of High Heterogeneous Thin Interbedding Layers."
[11] E. BinAbadat, H. Bu-Hindi, O. Al-Farisi, A. Kumar, K. Zahaf, L. Ibrahim, Y. Liu, C. Darous, and L. Barillas, "Complex carbonate rock typing and saturation modeling with highly-coupled geological description and petrophysical properties."
[12] O. Alfarisi, Z. Aung, and M. Sassi, “Deducing Optimal Classification Algorithm for Heterogeneous Fabric,” *arXiv preprint arXiv:2111.05558*, 2021.
[13] O. Alfarisi, A. Raza, H. Zhang, D. Ozzane, M. Sassi, H. Li, and T. Zhang, “3D Geometrical Untangling of Heterogeneous Fabric Darcy’s Flow using the Morphology Decoder,” 2022.
[14] O. Alfarisi, A. Raza, and T. Zhang, “The Discovery of Calcite Intrinsic Wettability by the First-Ever Optical Illumination Inside Dark Fluid using IRIDW Apparatus.”
[15] O. Alfarisi, D. Ouzzane, M. Sassi, and T. Zhang, “Digital Rock Typing DRT Algorithm Formulation with Optimal Supervised Semantic Segmentation,” *arXiv preprint arXiv:2112.15068*, 2021.
[16] O. Alfarisi, D. Ouzzane, M. Sassi, and T. Zhang, “The Understanding of Intertwined Physics: Discovering Capillary Pressure and Permeability Co-Determination,” *arXiv preprint arXiv:2112.12784*, 2021.
[17] O. Alfarisi, A. Raza, D. Ouzzane, H. Li, M. Sassi, and T. Zhang, “Morphology Decoder: A Machine Learning Guided 3D Vision Quantifying Heterogenous Rock Permeability for Planetary Surveillance and Robotic Functions,” *arXiv preprint arXiv:2111.13460*, 2021.
[18] O. Alfarisi, A. Raza, H. Zhang, D. Ozzane, M. Sassi, and T. Zhang, “Machine Learning Guided 3D Image Recognition for Carbonate Pore and Mineral Volumes Determination,” *arXiv preprint arXiv:2111.04612*, 2021.
[19] O. Al-Farisi, M. Sassi, and D. Ouzzane, “Digital Rock Typing,” *InterPore2021*, 2021.

[20] O. Alfarisi, A. Raza, D. Ouzzane, M. Abdelsalam, S. Alzaabi, M. Sassi, and T. Zhang, “Morphology Decoder: Untangling Heterogeneous Porous Media Texture and Quantifying Permeability and Capillary Pressure by Semantic Segmentation.”
[21] O. Alfarisi, “Physics-augmented Machine Learning Classification of 3D Vision Morphology for Digital Rock Typing,” Khalifa University of Science, 2019.
[22] O. Alfarisi, A. Raza, D. Ozzane, M. Sassi, H. Zhang, H. Li, K. Ibrahim, H. Alhashmi, H. Alhammadi, and T. Zhang, “Morphology Decoder to Predict Heterogeneous Rock Permeability with Machine Learning Guided 3D Vision,” *arXiv preprint arXiv:2111.13460*, 2021.
[23] O. Al-Farisi, H. Zhang, A. Raza, D. Ozzane, M. Sassi, and T. Zhang, "Machine learning for 3D image recognition to determine porosity and lithology of heterogeneous carbonate rock."
[24] H. Li, O. AlFarisi, B. Voort, C. Dimas, and T. Zhang, "Pore-Scale Experimental and Numerical Study on Permeability Characterization of Abu Dhabi Offshore Carbonate Micromodel."
[25] A. M. Serry, O. Al-Farisi, M. Al-Marzouqi, and S. Budebes, "Estimation of Water Saturation in Water Injector Wells, Drilled Across Tight Carbonate Formations, Using Resistivity Inversion."
[26] O. Al-Farisi, H. Belhaj, F. Yammahi, A. Al-Shemsi, and H. Khemissa, "Carbonate Rock Type Matrix RocMat, The Ultimate Rock Properties Catalogue." p. V006T11A007.
[27] A. M. Serry, S. Aziz, O. Al-Farisi, M. Al-Marzouqi, and S. Budebes, "Resolving Water Saturation Estimation in Thin Carbonate Reservoirs Using Resistivity Inversion." pp. cp-287-00302.
[28] O. Al-Farisi, *Carbonate rock matrix, RocMate: A novel static modeling technique*: The Petroleum Institute (United Arab Emirates), 2012.
[29] O. Al-Farisi, S. Budebes, O. Saif, T. Hamdy, A. Al-Felasi, and A. Sarri, "Permeability Determination in Fractured & Non-Fractured Carbonate Reservoir; Using Innovative Multi Property Threshold Analysis Approach of Basic Log Data."
[30] O. Saif, T. Hamdy, M. Al-Marzouqi, and F. Yammahi, "Carbonate Archie exponents correction model and variable determination."
[31] G. M. Mercado, H. Ikawa, O. Al-Farisi, R. Ramamoorthy, W. H. Borland, K. Malik, and S. Ali, "Data Gathering For Seismic Synthetic Tie In Very Large, Washed Out And Cased Boreholes: An Application For Modern Borehole Acoustics And Neutron Capture Spectroscopy."
[32] M. E. Elsaid, A. Belgaied, F. Al-Ginibi, and O. Al-Farisi, "Abu Dhabi heterogeneous carbonate: New upscaling approach of detailed 3D geological model."
[33] O. Al-Farisi, M. Elhami, A. N. Barkawi, M. Al-Marzouqi, G. Al-Jefri, and T. Kadada, "Quantification of Fracture Permeability From Micro Resistivity Logs in Offshore Abu Dhabi Reservoir."
[34] D. Boyd, A. Al-Hendi, O. Al-Farisi, and M. Okuyiga, "Two Generations of Thermal Decay Tools: A Comparison in a Common, Friendly, Borehole Environment."

[35] O. Al-Farisi, A. Belgaied, M. Elhami, T. Kadada, G. Al-Jefri, and A. N. Barkawi, "Electrical Resistivity and Gamma-Ray Logs: Two Physics for Two Permeability Estimation Approaches in Abu Dhabi Carbonates."
[36] O. Al-Farisi, N. Dajani, D. Boyd, A. Al-Felasi, and F. Al-Khatib, "Monitoring and Controlling the Quality of Well Log Information."
[37] O. Al-Farisi, N. Dajani, D. Boyd, and A. Al-Felasi, "Data management and quality control in the petrophysical environment."
[38] O. Al-Farisi, A. Belgaied, H. Shebl, G. Al-Jefri, and A. Barkawi, "Well Logs: The Link Between Geology and Reservoir Performance," *Abstract Geo2002,* vol. 96, 2002.
[39] A. Belgaied, O. Al-Farisi, S. Al-Ghusain, H. Al-Muntheri, M. Al-Marzouqi, and M. Petricola, "Comparing the accuracy of fluid saturation derived from different logging measurements: past, present and future methodology."
[40] M. Al Marzouqi, O. Al-Farisi, M. M. Amer, A. Al-Habshi, and E. Lund, "Enhanced Gas-Saturation Determination in Abu Dhabi Offshore Reservoirs Through Integrated Pulsed and Thermal Neutron Log Approach." pp. SPE-101990-MS.
[41] M. Al-Marzouqi, O. Al-Farisi, A. Al-Marzouqi, Al-Neami, and A. Hicham Abu Chaker, "Reservoir monitoring logging campaigns in offshore Abu Dhabi are handled with Collaborative Quality Value Assurance Project Management Approach," 2008.
[42] M. Attia, and A. Al-Habshi, "An innovative approach in tracking Injected water front in carbonate Reservoir off shore Abu Dhabi."
[43] M. Al-Marzouqi, O. Al-Farisi, M. M. Amer, A. Serry, and F. Yammahi, "Acid Effect Life Cycle in Carbonate Reservoir, Field Case."
[44] H. Li, W. Yang, H. Huang, S. Chevalier, M. Sassi, T. Zhang, K. Zahaf, and O. Al-Farisi, "Pore-scale lattice boltzmann simulation of oil-water flow in carbonate rock with variable wettability."
[45] H. Zhang, O. Al-Farisi, A. Raza, and T. Zhang, "NMR-MRI characterization of low-salinity water alternating CO2 flooding in tight carbonate." pp. 205-208.
[46] A. Zekri, H. Al-Attar, O. Al-Farisi, R. Almehaideb, and E. G. Lwisa, "Experimental investigation of the effect of injection water salinity on the displacement efficiency of miscible carbon dioxide WAG flooding in a selected carbonate reservoir," *Journal of Petroleum Exploration and Production Technology,* vol. 5, pp. 363-373, 2015.
[47] A. Fernandes, G. Radhakrishan, and O. Al Farisi, "Regional and international references for the implementation of GRE lining technology for downhole tubing to improve flow assurance in Abu Dhabi oil and gas upstream applications." pp. 193-196.
[48] A. A.-M. Sultan Al-Mansouri, Farhaad Al-Awadhi, Fahmy Fadi, Ameen Al-Kasasbeh, Khamis Ahmed, Omar Al-Farisi, *Oil Well Drill Bit*, 2016.
[49] K. Fan, H. Belhaj, and F. Fahmy, "Price Projection Model for New Explorations after the Lost Control of Majors."