Contribution ID: **669**

Type: **Oral Presentation**

Surface relaxivity and its role in permeability prediction

Wednesday, 24 May 2023 12:30 (15 minutes)

In the limit of the so-called fast diffusion regime, the solid-fluid interaction plays the major role in the Nuclear Magnetic Resonance (NMR) transverse relaxation phenomenon, and the saturating fluid characteristic transverse relaxation time (T2) is inversely proportional to the surface-to-volume ratio (S/V) of the pore where it resides [1]. The surface relaxivity (ρ), a parameter that characterizes the strength of relaxation induced by the solid/fluid interface, is the proportionality constant that relates T2 to S/V. In that sense, when an estimate for ρ is available, the T2 distribution (a distribution of characteristic relaxation times) can be converted into a S/V distribution straightforwardly. Indeed, the more accurate we estimate ρ, the better we estimate the S/V distribution and, therefore, the better we estimate all the subsequent related petrophysical deliverables [2]. We explore this notion in the present work, within the context of Machine Learning. To do that, we divided the study into three parts: In the first part, we used an in-house developed Random Walk implementation to simulate the T2 distribution in a large collection of in-house generated 3D digital rocks, using a single value for ρ. In addition, for the same collection of digital rocks, we estimated the absolute permeability with the aid of an in-house developed Voxel-Based Finite Element implementation. We then trained and tested a Random Forest Machine Learning model for estimating the permeability from the T2 distribution using the 10-fold Cross Validation protocol. The second part of the study was analogous to the first one, but this time we used several rondomly-chosen different realistic values for ρ, one for each rock, to simulate the T2 distributions. Then, we trained and tested again the Machine Learning model for estimating the permeability from the T2 distribution using, once more, the 10-fold Cross Validation protocol. The third part of the study was similar to the second one, except that, now, we added one more stage in the workflow: for each rock, using the value of ρ used to simulate its T2 distribution, we converted the T2 distribution into a S/V distribution. We did that for the entire rock collection. Then, we trained the Machine Learning model for estimating the permeability from the S/V distribution (instead of the T2 distribution). We compare the success rate for the three cases and show that it is high and practicaly the same for the first and third parts of this work, but lower for the second part.

[1] Brownstein, K.R., Tarr, C.E., 1979. Importance of classical diffusion in NMR studies of water in biological cells. Phys. Rev. A 19, 2446–2453

[2] Souza, A., Carneiro, G., Zielinski, L., Polinski, R., Schwartz, L., Hürlimann, M.D., Boyd, A., Rios, E.H., Santos, B.C.C. dos, Trevizan, W.A., others, 2013. Permeability Prediction Improvement Using 2D NWR Diffusion-T2 Maps, in: SPWLA 54th Annual Logging Symposium. Society of Petrophysicists and Well-Log Analysts

Participation

In-Person

References

[1] Brownstein, K.R., Tarr, C.E., 1979. Importance of classical diffusion in NMR studies of water in biological cells. Phys. Rev. A 19, 2446–2453

[2] Souza, A., Carneiro, G., Zielinski, L., Polinski, R., Schwartz, L., Hürlimann, M.D., Boyd, A., Rios, E.H., Santos, B.C.C. dos, Trevizan, W.A., others, 2013. Permeability Prediction Improvement Using 2D NWR Diffusion-T2 Maps, in: SPWLA 54th Annual Logging Symposium. Society of Petrophysicists and Well-Log Analysts

MDPI Energies Student Poster Award

No, do not submit my presenation for the student posters award.

Country

Brasil

Acceptance of the Terms & Conditions

Click here to agree

Energy Transition Focused Abstracts

Primary authors: LEIDERMAN, Ricardo (Universidade Federal Fluminense); Mr CUNHA, Alexsander (Institute of Computing, Fluminense Federal University); DA SILVA VIANNA, Rafael

Co-authors: VIANNA, Pedro (Universidade Federal Fluminense); SOUZA, André (Universidade Federal Fluminense); CORTEZ LOPES, Pedro (Universidade Federal Fluminense); MAUÉS BRABO PEREIRA, André (Institute of Computing, Fluminense Federal University); BAGUEIRA, Rodrigo (Universidade Federal Fluminense)

Presenter: LEIDERMAN, Ricardo (Universidade Federal Fluminense)

Session Classification: MS06-B

Track Classification: (MS06-B) Interfacial phenomena across scales