PostDoc Proposal
Tracking Salt/Rock Interface by a Stochastic Dynamic

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KeyWords

Salt Tectonics, Analog Model, Temporal tracking, Level-Set, non-linear stochastic filtering, particle filter

Context

Salt tectonics, as a sub-discipline of structural geology, describe deformation structures developing due to the special deformation behavior of salt. The prime interest in salt tectonics comes from the oil industry because many of the world's great hydrocarbon provinces lie in salt basins (e.g., Gulf of Mexico, Persian Gulf, North Sea, Lower Congo Basin, Campos Basin, and Pricaspian Basin)[4]. Furthermore, the presence of salt in a basin affects virtually all aspects of a hydrocarbon system. Salt cavities, for example have been or are being considered for long term storage of radioactive waste.[2] So, having a good understanding of the deformation and stress state both within the salt structures and the surrounding host rock is important. So analog experiments, in particular those performed in a computed tomography scanner, can aid understanding of the kinematics and structural evolution of such complex systems characterized by the presence of salt structures. [5, 3]. Analog models are successfully used since a long time to reproduce the geometries and kinematic evolution of specific geologic context and may help to access temporal changes of salt flow patterns. Physically scaled sandbox experiments provides 3D images at paced rate. By this way, temporal evolution of salt structures (more precisely the salt/rock interface) may be investigated and tracked from an image analysis point of view.

To go toward this objective, the Fluminance Group(INRIA) has developped an expertise in data assimilation and fluid motion tracking. They have devised a non-linear stochastic filtering technique able to track in 2D the state of a free curve from image data. The curve is defined by an implicit level-set representation and the stochastic dynamics is data driven and expressed on the level-set function.[1]

First develop in 2D with a view to handle images provided in biology or meteorology, this method seems to be promising to track salt front in geology as illustrated on the Fig1.

Goals

The first goal of this work is to take in charge the theoretical and technical(source code) material of what have been done during previous work at INRIA. Then to compile and adapt it in order to fit the salt tectonic 2D cross sections of analog models. The particle filter used in this approach is

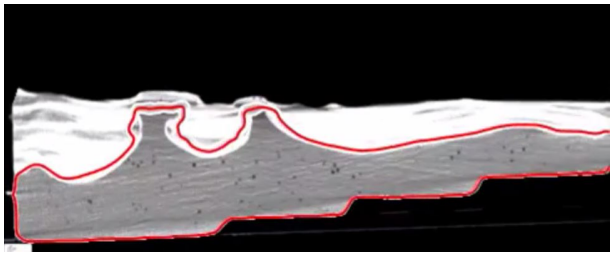

Figure 1: close curve in red that represents salt/rock interface in 2D at one time step

really computationally intensive. So special attention should then be given to the implementation, and HPC skills are an advantage to take benefits from the IFPEN supercomputer ENER440. Once validated on 2D geological cross-sections, theoretical extension of the Level-Set framework may be investigate to take full advantage of available 3D information.

General Informations

The PostDoc will take place at IFPEN in Rueil-Malmaison, France and will be done in close collaboration with Fluminance Research Group, an INRIA group based in Rennes which has developed the tracking methodology.

Application, contact

Please send a CV and short statement of interest to jean-francois.lecomte@ifpen.fr. Do not hesitate to contact us if you have any questions.

References

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