Muti-Dimensional Reservoir Simulation Platform

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Abstract. The muti-dimensional reservoir simulation platform is a digital twin reservoir system that integrates seismic, geology, numerical simulation and production. Based on years of accumulation, we make full use of late-comer advantages and adapt to the tide of networking and cloudification to fully integrate with informatization. In the oil and gas industry applications, we regard integration and sharing as our goal. The muti-dimensional reservoir simulation platform will realize application integration on the basis of digital integration realized by informatization and maximize knowledge sharing on the basis of data sharing realized by informatization.

1. Module Store

The muti-dimensional reservoir simulation platform includes five modules: seismic interpretation, geological modeling, numerical simulation, production analysis and three-dimensional visualization technology module, which form the module store. Each module can provide services for the oilfield separately, or provide customized assembly services and customized interface adaption services for different modules according to the needs of the oilfield, as ‘figure 1’ - ‘figure 5’.

Figure 1. Seismic interpretation.  
Figure 2. Geological modeling.
2. Service Mode

2.1. Integrated Software Licensing Service
The services include: software licensing and leasing services, upgrading, maintenance, training and so on.

2.2. Module Store and Customized Service
The services include: providing a variety of specialized modules and information modules; providing customized assembly services and customized interface adaption services for different modules according to demand.

2.3. Research Service
The services include: relying on independent technology and platform, it provides professional oilfield technology services such as oilfield investment and economic evaluation[2], geological analysis, reservoir fine description, evaluation of favorable reservoir and prediction of development plan.

3. Product Advantages
The advantages of our product should be formatted as follows:

- Safer: conform to the national trend of professional software localization and create a completely self-developed multi-dimensional simulation software product for reservoirs. The key technology is developed by ourselves, which is safer and more controllable.
- Better understanding of industry: to solve the confusion of management and the disunity of format of fine reservoir description results[3].
- More comprehensive: It integrates seismic interpretation, geological modeling, numerical simulation, production optimization and 3D visualization to realize the whole business process support of reservoir development and production.
- More accurate: The finite volume method numerical simulation technology can not only realize the fine description of the reservoirs in complex geological conditions, but also solve the phenomenon of chaneling and flowing backward during multiple-zone commingled production and significantly improve the authenticity of simulation results.
More flexible: It not only builds the interface of professional database, but also is compatible with other foreign professional software models. It has the advantages of simple deployment, flexible capacity expansion and multiple development interfaces.

Cost-effective: compared with other professional software, the price and maintenance cost of MDS products are relatively low and cost-effective.

Collaborative sharing: build a collaborative research environment for fine reservoir description to achieve data collaboration, result collaboration, application collaboration and improve work efficiency.

4. Product Features
The platform include 5 modules: Earthquake interpretation, Multi-dimensional geological modelling, Number simulation, production analysis and three-dimensional visualization.

4.1. Earthquake Interpretation
The seismic interpretation module uses seismic data and well data to predict and describe the structure and reservoir characteristics, as ’figure 6’ - ’figure 7’.

4.2. Multi-dimensional Geological Modelling
Relying on independent geological modeling technology, we can use facies-controlled modeling to build fine geological models such as porosity, permeability, sand-to-ground ratio, water saturation, etc[4]. They are mainly used to digitally express and describe geological bodies and also provide a basic model for the later numerical simulation, as ’figure 8’ - ’figure 13’.
4.3. Numerical Simulation

The numerical simulation adopts the finite volume method, which is not only suitable for multi-dimensional arbitrary mesh reservoir numerical simulation, but also more truly describes the flow characteristics of crude oil in the reservoir to shorten the simulation time[5]. More importantly, this technology can take the situation of channeling and flowing backward into account and meet the demand of dynamic simulation for low permeability reservoir models as ‘figure 14’- ‘figure 19’. Through the direct connection with the database and history matching technique, the data and models can be updated real-time. After the update is completed, researchers can carry out the remaining oil distribution study and forecast the development plans for the whole area, well group or the single well, etc. The production indexes can be viewed and compared in the post-processing module.
4.4. 3D Visualization Module

3D visualization module is based on OpenGL and WebGL technology. It adds a large number of independent research after years of secondary development. Compared with other commercial numerical simulation software, the multi-dimensional reservoir simulation platform does not contain any commercial plug-ins and has better 3D display ability. It supports model data visualization and wellbore data visualization, as ‘Figure 20’ - ‘Figure 25’.
5. Conclusion
The multi-dimensional reservoir simulation platform is developed independently. It includes seismic interpretation, geological modeling, numerical simulation, production analysis and three-dimensional visualization. It is helpful to reduce cost and increase efficiency.

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