数学与系统科学研究院

计算数学所学术报告

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报告题目：**Progress of Subsurface Depth Imaging Algorithms**

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Abstract：

Subsurface depth migration algorithms are broadly categorized as ray-based and wave equation based methods: the

ray-based methods include Kirchhoff and beam migrations, while the wave equation group consists of one-way wave equation based migration and full wave equation based reverse-time migration. Each of them has its advantages and limitations.

The Kirchhoff method was the dominant imaging algorithm in the oil and gas industry in late 1990s. It can image steeply dipping structures including overhangs. It is efficient, flexible and target oriented. However, its theory is developed under the high frequency approximation and the typical implementation is single arrival, these methods are not effective in imaging complicated structures.

Like the Kirchhoff migration algorithms, beam migration can properly handle steeply dipping structures. It is also a target oriented scheme and is inherently multi-arrival. But, beam migrations are fundamentally still ray-based methods, which seek asymptotic solutions to the acoustic wave equation, they fail to function properly in complicated velocity models.

One-way wave equation based migration methods utilize the paraxial approximation to the wave equation. In early 2000s, this method was widely used, since it handled multi-arrivals automatically and consistently produced superior images than

Kirchhoff methods for complicated structures. However, a typical one-way wave-equation based migration method can not image steeply dipping reflectors, especially those near or beyond 90°**.**

Reverse-time migration directly solves the full (two-way) wave equation for wavefield propagation, it has no dip limitation, and out performs all of other methods in imaging complicated structures. However, reverse-time migration is typically much more expensive than any of the above methods. In addition, the image in reverse time migration is constructed by the zero-lag cross-correlation of the extrapolated source and receiver wavefields. This imaging condition provides the correct kinematics and is extremely simple to implement. But, it produces a significant amount of large amplitude noises at sharp interfaces that contaminate the image.

In this presentation, I will briefly review the theory of each of these imaging algorithms and demonstrate their applications to a common dataset to show their advantages and limitations. Then, I will discuss in detail the noises in reverse-time migration and propose a new imaging condition to get rid of them.

欢迎大家参加！