The Adaptive Complex Shock Diffusion for Seismic Random Noise Attenuation
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Introduction
Seismic images always have low signal-to-noise ratio (SNR), especially under complex acquiring conditions. That makes it difficult to suppress random noise and extract seismic signals simultaneously.

The diffusion filtering based on partial differential equations has great potential capacities in texture protection and noise attenuation of seismic images.

An adaptive complex shock diffusion (ACSD) method is proposed to preserve the seismic textures by combining the CSD and the structure tensor. A texture detection function is constructed based on the eigen values of the Hessian matrix, which contains seismic texture structure information. The proposed texture detection function provides a tool to adjust the threshold function of the diffusion coefficient in the gradient direction.

Methods
We utilize the structure tensor to get the texture information of the seismic images. The texture detection function D is obtained by the two eigenvalues µ1 and µ2 of the tensor structure.

\[ D = \frac{1}{n} \sum_1^2 \mu_i^2 \]

where the parameter n can be adjusted according to the various images in order to highlight the edges of the seismic images.

After obtaining the texture detection function D, we make it be the independent variable of the threshold detection function K, and the formula is defined as:

\[ K = \text{exp}(\text{Im}( )/(1+K\mu D)) \]

The ACSD can be stated as:

\[ I_{ACSD} = I_0 + K \cdot \text{exp}(\text{Im}( )/(1+K\mu D)) \]

Results
A texture detection function is constructed by using the texture detection function to control the diffusion coefficient in the gradient direction according to the structure characteristics of seismic images. The theoretical analysis and experimental results demonstrate that the ACSD has better capacities of seismic random noise attenuation and the seismic signal preservation compared to the original CSD.

Conclusions
A texture detection function is constructed using the structure tensor, then we propose an adaptive threshold function by utilizing the texture detection function to control the diffusion coefficient in the gradient direction according to the structure characteristics of seismic images. The ACSD is better than the CSD in noise attenuation, details and coherence preservation of seismic events.

Acknowledgement
This work was supported in part by the National Natural Science Foundation of China under Grant 41574096; The National Natural Science Foundation of Jilin province of China under Grant 2017011187JC.

References