# Self-organized criticality induced by randomness in block-spring models and the Gutenberg=Richter law

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The Block-spring model is a simple mathematical model for earthquakes proposed by Burridge and Knopoff. Later, Carlson and Langer performed numerical simulations of a uniform block-spring model with velocity-weakening friction. They found that the slip-size distribution obeys a power law in a small scale. Their model exhibits a kind of spatio-temporal chaos and the slip size distribution is dur to the chaotic behavior. Many authors studied a variety of block-spring models. In this presentation, we will show numerical results of a block-spring model with quenched randomness in the velocity-strengthening friction. When the pulling force is stationary, there is a continuous transition from a state pinned by the quenched randomness to a sliding state. When the external force is applied through a spring, the pinning and sliding repeat randomly. The effective pulling force fluctuates around the critical value of the pinning-depinning transition. The phase transition is self-organiized even if the parameter is not controlled. As a result of the criticality, the slip size distribution obeys a power law. We consider that the power law is caused by the self-organized criticality to the pinning-depinning transition in the random media. Our model is related to the asperity theory in that the spatial inhomogeneity is important.

Keywords: block-spring model, power law, pinning transition, self-organized criticality