Effects of Periodic Stress Perturbations on Earthquake Nucleation Processes

*Saito Takuya[1], Takahiro Hatano[1]

1. The University of Tokyo

Ocean tides, snowfalls or rainfalls may periodically vary the stress states on a fault, but the amplitudes of periodic stresses are much smaller than the amounts of the ordinary earthquake stress drops. Thus, the periodic perturbations are not thought to be commonly so involved in the earthquakes. On the other hand, there have been reported specific areas or events, where the occurrences of the earthquake could be correlated to the perturbations.
While there are various studies, we perform the numerical and theoretical study of the earthquake nucleation processes under the periodic stress perturbation in order to organize and develop the arguments. Especially, this study focuses on the statistics for the perturbation phases to promote the nucleation growth.
If using the conventional elastic mechanics and rate-and-state friction, the time evolution is written in a deterministic way. Our framework here weighs the probability by considering the arbitrarily-distributed initial phases or by incorporating the noise. Observing the phases at the moment when the nucleus reaches some threshold velocities, we establish the probability density functions (PDFs) for the perturbation phases. The numerical simulations demonstrate the nonuniform distributions which are found to take the sinusoidal forms at the weak perturbations. In addition, the peak positions are affected by the perturbation conditions. We also present the analytical arguments about the sinusoidal forms and the peak positions on the PDFs, comparing them with the numerical results.