Three-dimensional distinct element (DEM) simulation of shear bands formation and their time development for strike-slip faults

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There have been many studies to elucidate shear band formation and its development process with fault displacement using model experiments and numerical simulations employing the finite element or boundary element methods (e.g. Sawada & Ueda, 2009; Taniyama, 2011). Many of these used models with uniform medium and strength.
Fault zone in nature is typical NON-uniform region as fault zone is weaker than its surrounding area. It is interesting where are shear bands formed and how do they develop as fault displacement increases.
However, it is difficult to perform model experiments for a non-uniform model, mainly because of difficulty in making a well-controlled non-uniform model.
We performed numerical simulations of shear band formation and its developing process, using a three-dimensional (3D) distinct element method (DEM) for three types of model. Every model has one or two vertical plate-like weak zones in the base model.
(1) Continuous model; one weak plate is located at the center of the base model (Fig.1a)
(2) Gap model: a non-weak part exists in the weak plate (Fig.1b).
(3) Step model: the weak plate displaces in a step (Fig.1c)
First, we examined the effect of the weak zone parameters (weak zone width and bond strength) on spatiotemporal change of shear band as fault displacement increase for the Continuous model.
Next, we examined effect of the gap length on forming shear bands and their spatiotemporal change for the Gap model, further, examined of them on the Step mode.
In this presentation, we show the results of these simulations and what they mean.

Keywords: strike-slip fault, Three-dimensional distinct element method, shear band