National Program Development in China
--LURR and CRS (Critical Sensitivity)
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I, New Status of the Chinese Core Participants
CAP (Center for Analysis and Prediction), CSB (China Seismological Bureau)
LNM (Laboratory of Nonlinear Mechanics), Institute of Mechanics, CAS
Peking University
Beijing University of Aeronautics and Astronautics
Seismological Bureau of Yunnan Province
Seismological Bureau of Xinjiang Atonomous Region ……
In these two years they have significant changes

1, Now the **CAP** is not only the **Center for Analysis and Prediction,**
 it is also **:**
*National Headquarters for Earthquake Disaster Mitigation—
*Center for National Digital Seismic Network
***The Data Center of the Crustal Movement Observation Network**
 ---- GPS Center
***The Center for Earthquake Precursor Observation Network**
***The VSAT satellite Communication Network Center.**
2, LNM
Now it is upgraded as the **State Key Laboratory** of Nonlinear Mechanics**.**

II, New developments of LURR (Load-Unload Response Ratio)
   Since the Inaugural Workshop of ACES there are a lot of developments in China on earthquake macro-simulation, micro-simulation, observation and laboratory experiment. Here just a brief introduction on LURR and CRS (**Cr**itical **S**ensitivity) is presented.
  During this period we have got some new developments of LURR including:
1, Micro-simulation with the lattice solid method.
2, Tempo-spatial scanning of LURR.
3, The random distribution of LURR under the assumption of Poisson model.
4, The relation between LURR and the critical point model.
   We conducted part of the items 1 and 4 cooperating with QUAKES, the University of Queensland, Australia.
   At present due to the research of mentioned above we have more confidence to predict (intermediate term) the location, magnitude and occurrence time of the ensuing strong earthquake.

III, LURR and CRS (Critical Sensitivity)
   The phenomenon that the system may become sensitive significantly to tiny external disturbance as approaching to catastrophe transition point is called CRS (Critical

Sensitivity). It can be observed in many systems.

Based on simple conceptual models (nonlinear mesoscopic dynamical model), it is found that the critical sensitivity might be a common feature of catastrophe transition in heterogeneous brittle media.

The sensitivity of energy release to external load can be measured by S_k

$$S_k = \frac{\sqrt{\Delta E_k'' / \Delta \sigma_k''}}{\sqrt{\Delta E_k' / \Delta \sigma_k'}}$$

ΔE_k ($\Delta E_k'$, $\Delta E_k''$) is the time series of energy release induced by increment of external load $\Delta \sigma_k$ ($\Delta \sigma_k' = \Delta \sigma_k + \alpha \overline{\sigma_c}$, $\Delta \sigma_c'' = \Delta \sigma_k + 2\alpha \overline{\sigma_c}$), $\overline{\sigma_c}$ is the mean strength of units, α is a small parameter (α ¡Ö10^{-2}—10^{-3}).

The simulation results show that prior to catastrophe transition point, S_k increases significantly and there is also an intermediate increase of sensitivity prior to larger event during the globally stable regime.

It is obvious that S_k is similar to LURR in our previous works so that **critical sensitivity** might be the underlying mesoscopic dynamical mechanism behind **LURR**

IV, Complexity and Strategy

The rupture of heterogeneous brittle media and earthquake present complexity:

*The catastrophe transition from globally stable accumulation of damage to catastrophic rupture.

*The macroscopic uncertainty, i.e. the diversity of catastrophe transition threshold for samples identical macroscopically.

Such complex behavior results in difficulty of rupture and earthquake prediction.

A scientific strategy to deal with such complex systems is to explore their universal feature, which may be helpful to go deep into the essence of the rupture phenomena and to provide some clues for rupture prediction and earthquake prediction.