

**Rheological heterogeneities,
crack arrest and healing
phenomena**

Healing types

1. CLASSICAL ENLARGING CRACK

- The dynamic problem is solved for homogeneous configurations
- No healing occurs: the fracture propagates without limit
- Non realistic; only reference case

2. ARTIFICIOUS ANALYTICAL MODIFICATION TO FRICTION LAW TO INCORPORATE HEALING

- *Perrin et al. (1995); Zheng and Rice (1998), ...*
- *Self – healing or short slip duration*

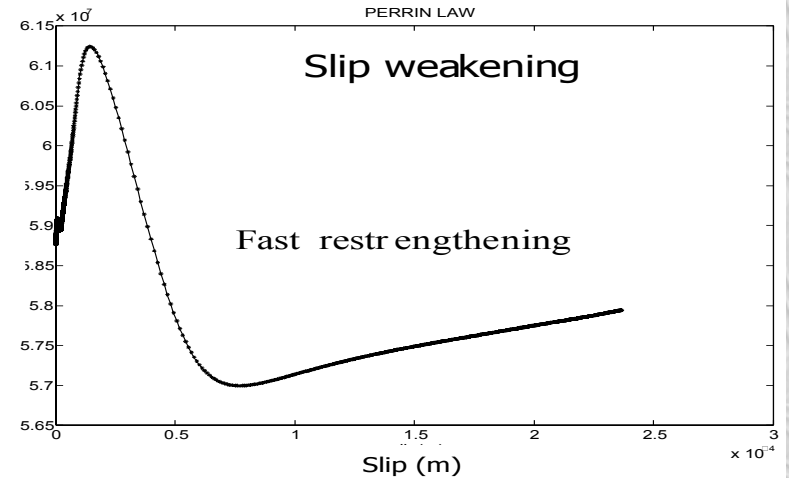
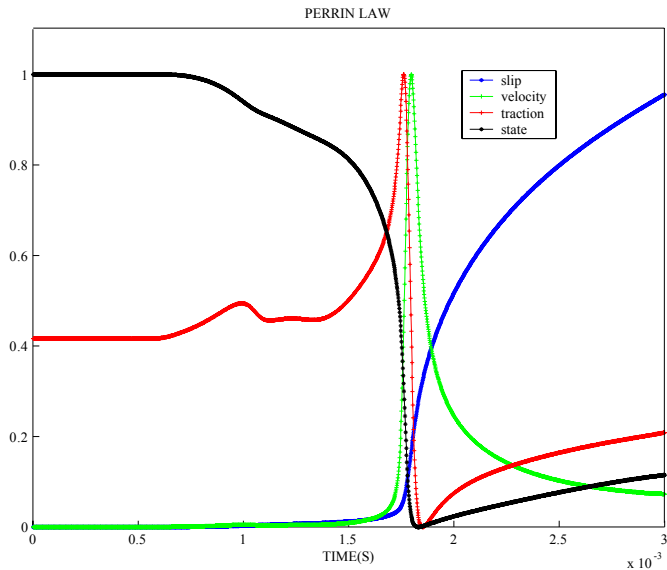
3. HETEROGENEOUS CONFIGURATIONs

- *Heterogeneities in the spatial distributon of frictional parameters*
- *Realistic configurations*
- *Barrier – healing vs. self – healing*



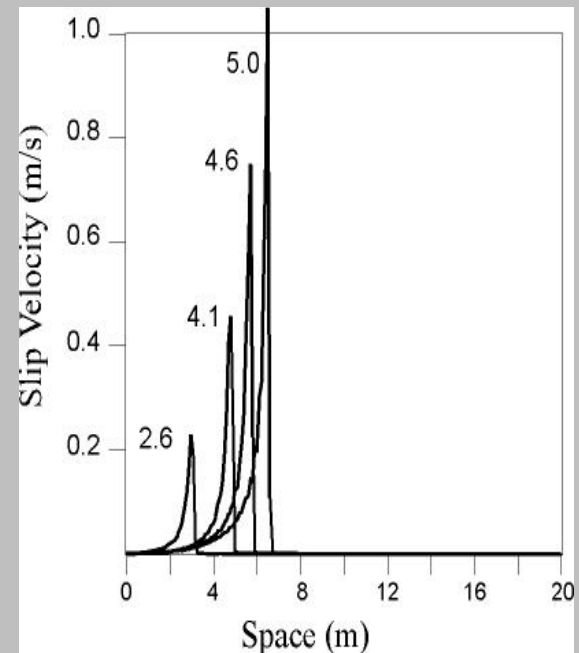
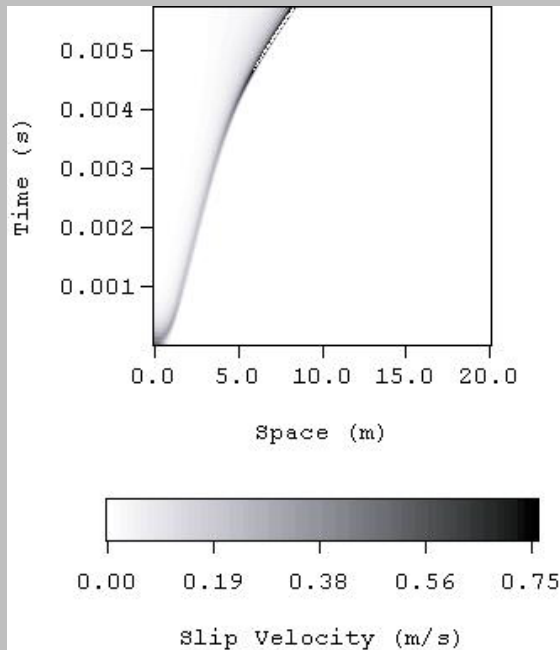
Self – healing with Perrin law

$$\left\{ \begin{array}{l} \tau = \left[\mu_* - a \ln \left(\frac{v + v_*}{v + v_p} \right) + b \ln \left(\frac{\Psi (v - v_p)}{L} + 1 \right) \right] \sigma_n^{eff} \\ \frac{d}{dt} \Psi = 1 - \frac{\Psi (v + v_p)}{L} \end{array} \right.$$



Self – healing with Carlson law

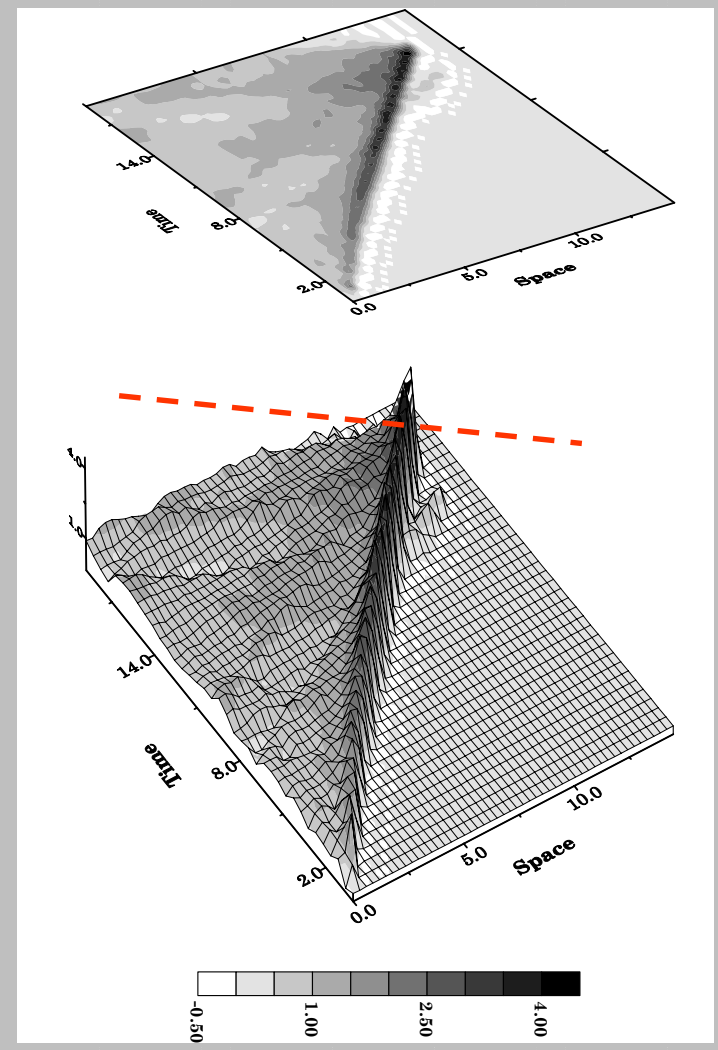
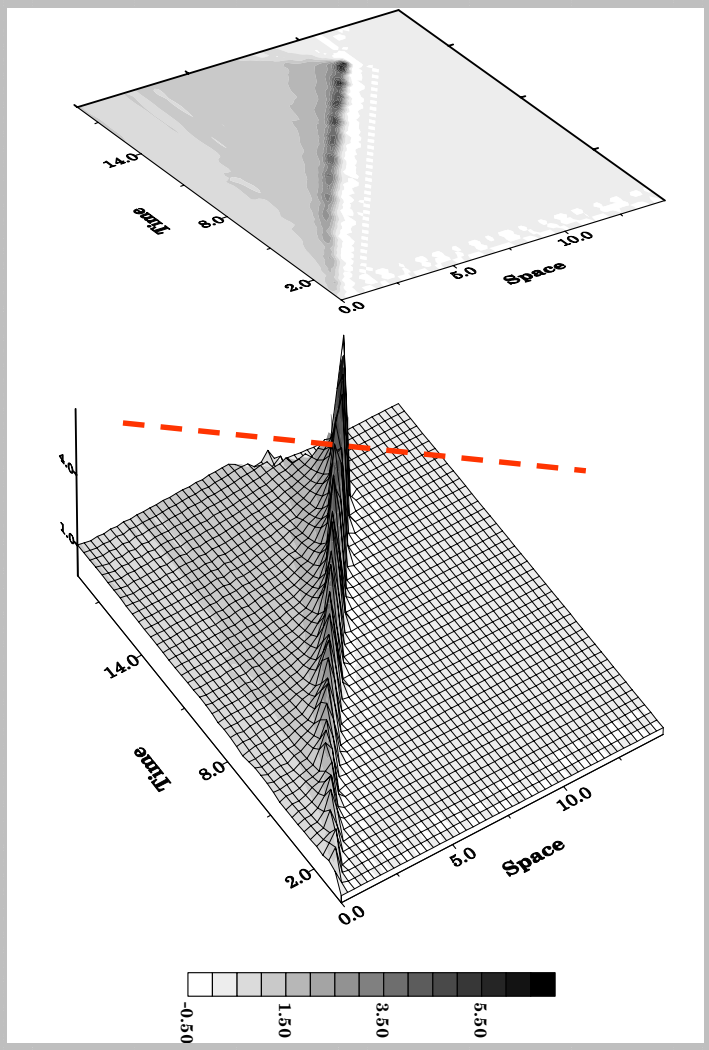
$$\left\{ \begin{array}{l} \tau = \left[\mu_* - a \ln \left(\frac{v_*}{v} + 1 \right) + b \ln \left(\frac{\Psi v_*}{L} + 1 \right) \right] \sigma_n^{eff} \\ \frac{d}{dt} \Psi = \frac{\gamma - \Psi}{t_{fh}} - \frac{\Psi v}{L} \end{array} \right.$$



Barrier – healing with SW

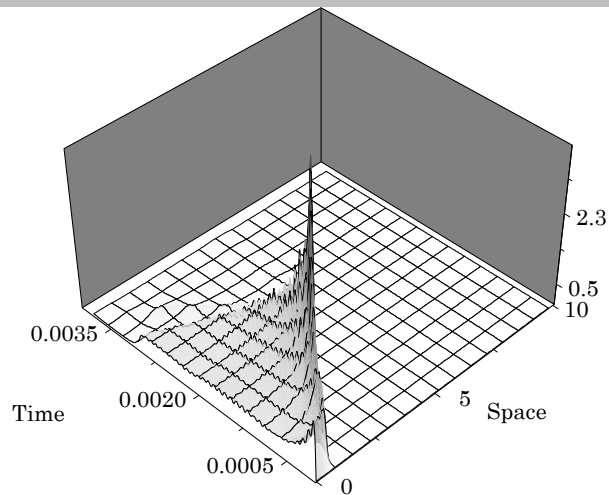
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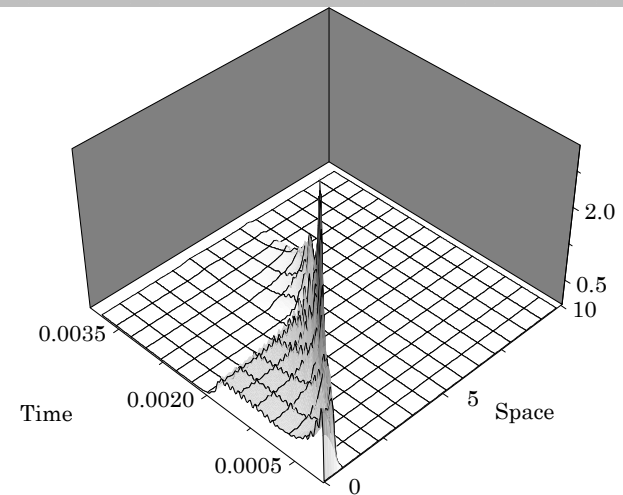


Healing with RS #1

**Barrier – healing:
heterogeneity of L parameter**

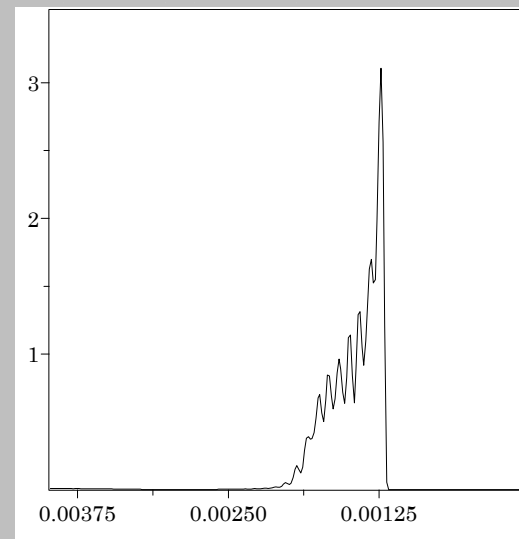
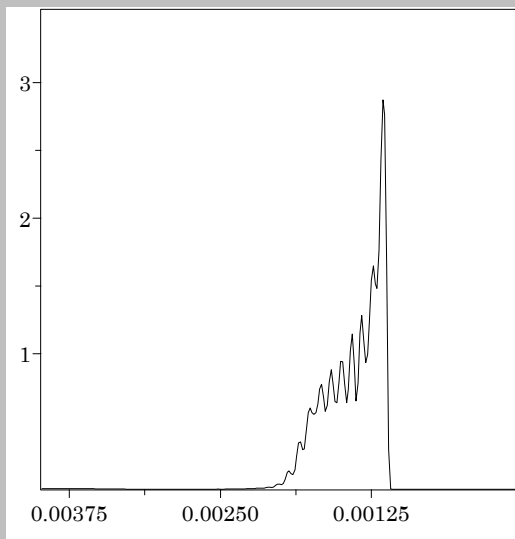
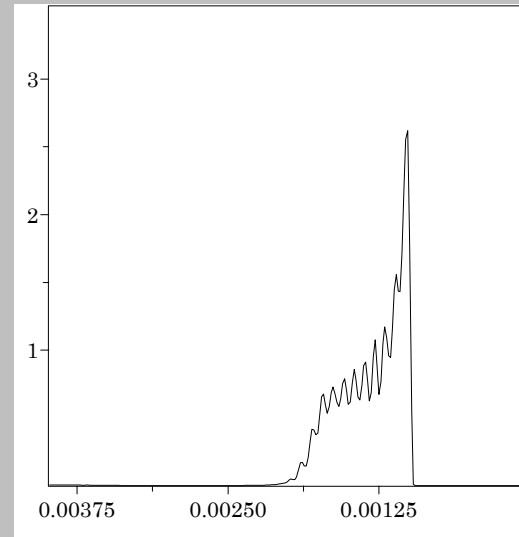
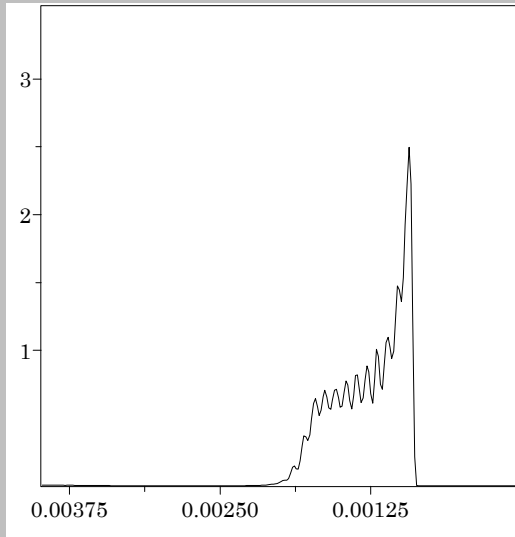


**Self – healing: heterogeneity
of a and b parameters**



2-D

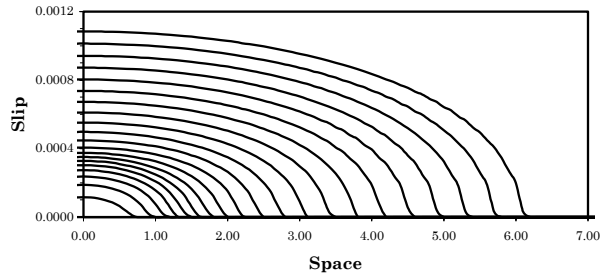
Healing with RS #2



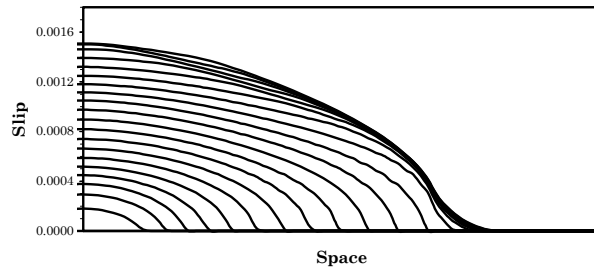


Healing with RS #3: DRF

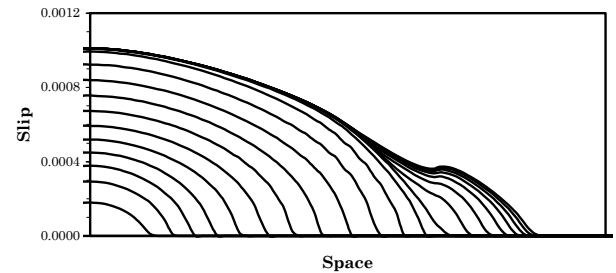
Classical enlarging crack



Barrier - healing



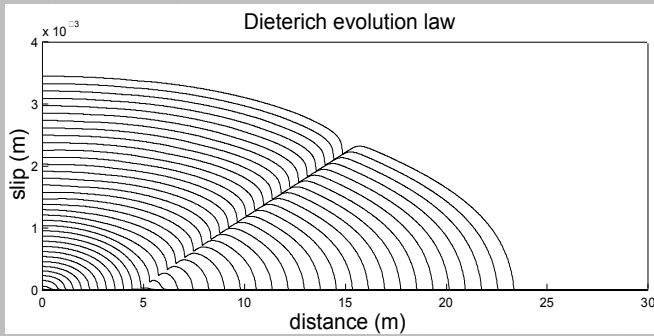
Self - healing



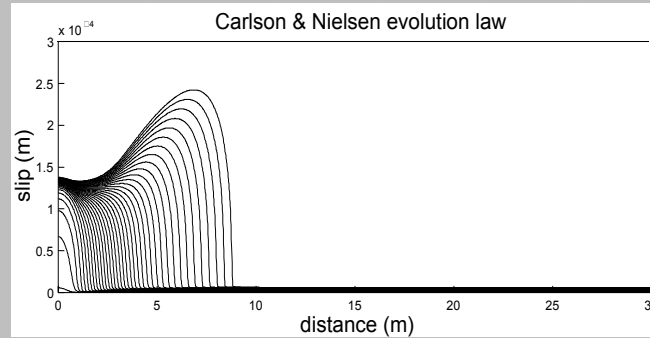


Healing with RS #4

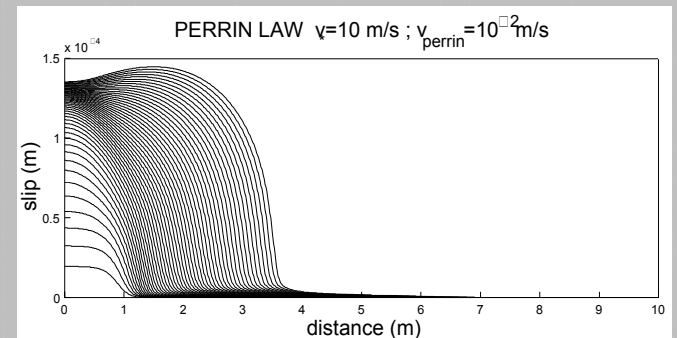
Classical enlarging crack



Self – healing with Carlson's law



Self – healing with Perrin's law



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