



**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**

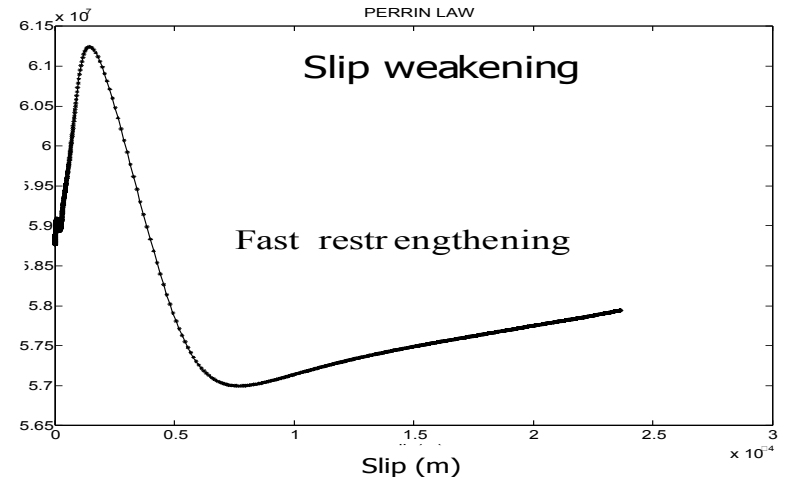
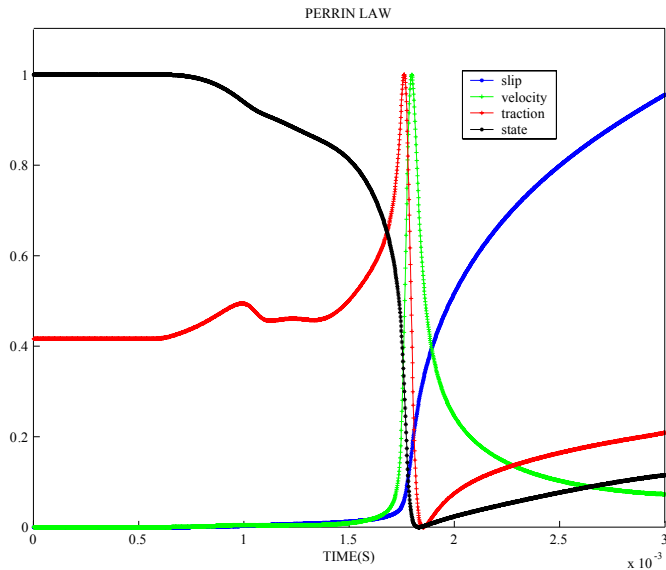
- *Perrin et al. ( 1995 ); Zheng and Rice ( 1998 ), ...*
- *Self – healing or short slip duration*

## **3. HETEROGENEOUS CONFIGURATIONs**

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

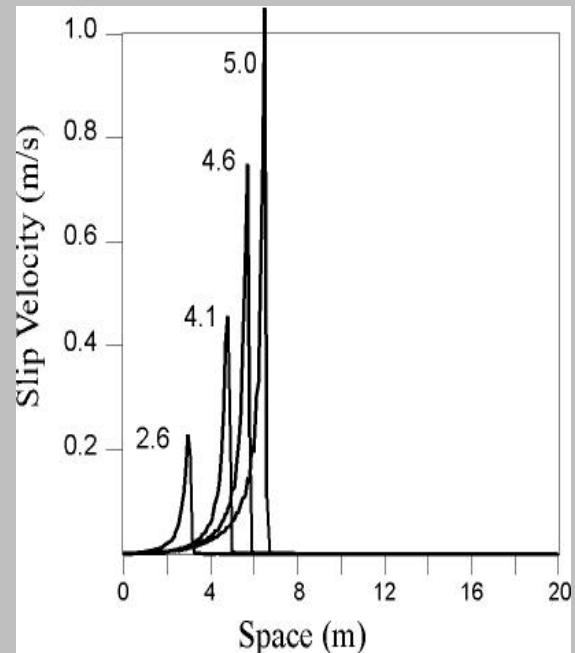
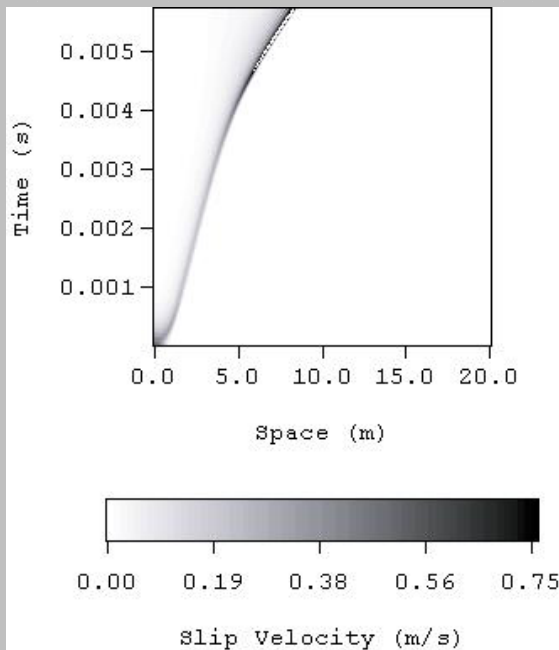
# Self – healing with Perrin law

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



# Self – healing with Carlson law

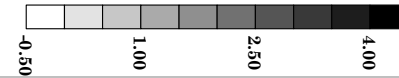
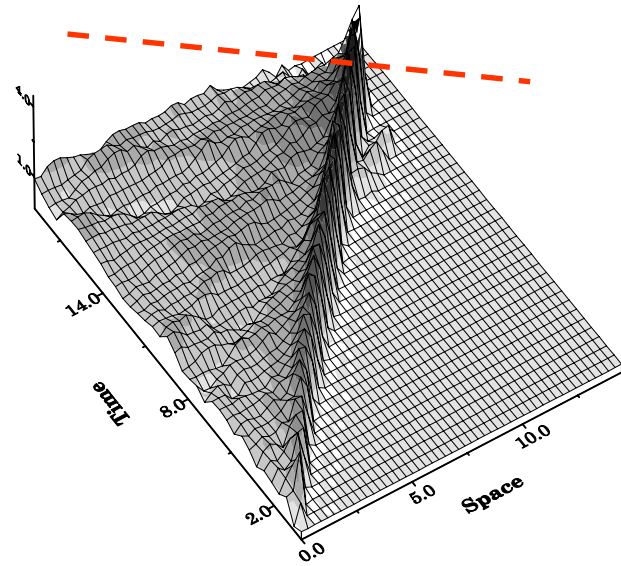
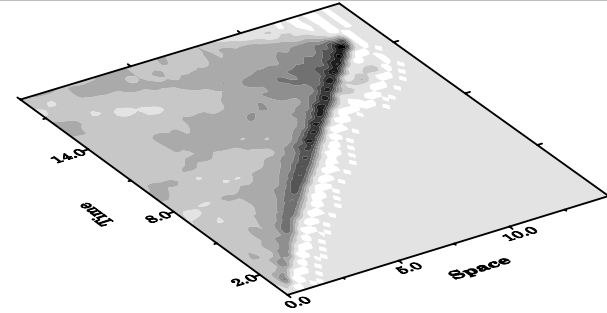
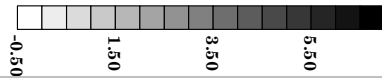
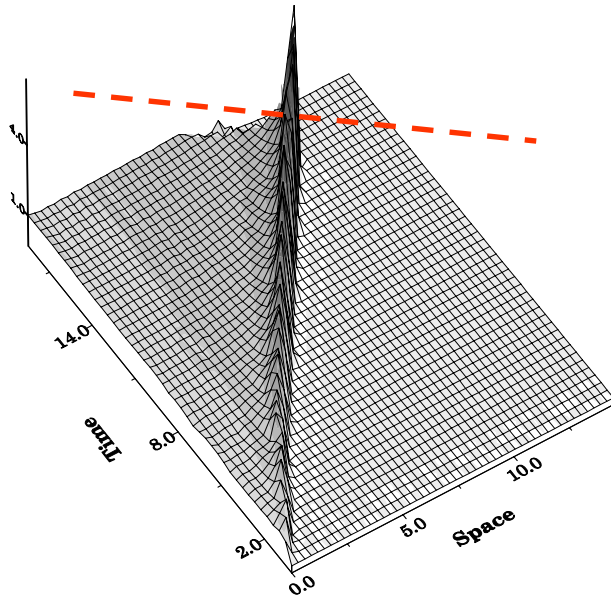
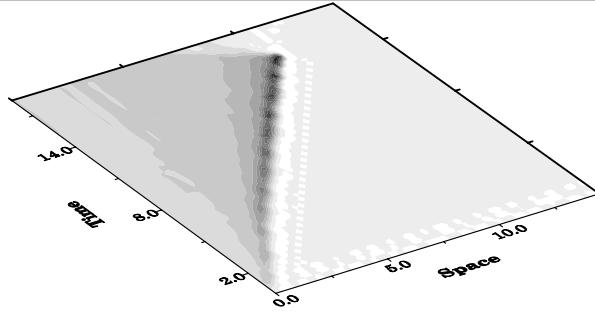
$$\left\{ \begin{array}{l} \tau = \left[ \mu_* - \alpha \ln \left( \frac{v^*}{v} + 1 \right) + b \ln \left( \frac{\Psi v^*}{L} + 1 \right) \right] \sigma_n^{eff} \\ \frac{d}{dt} \Psi = \frac{\gamma - \Psi}{t_{fh}} - \frac{\Psi v}{L} \end{array} \right.$$



# Barrier – healing with SW

BIE

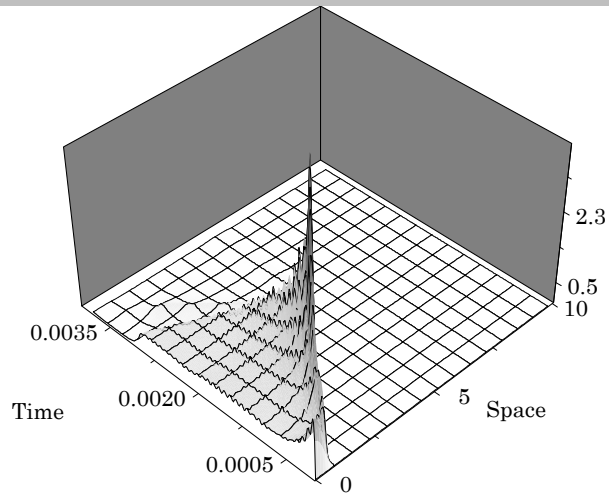
FD



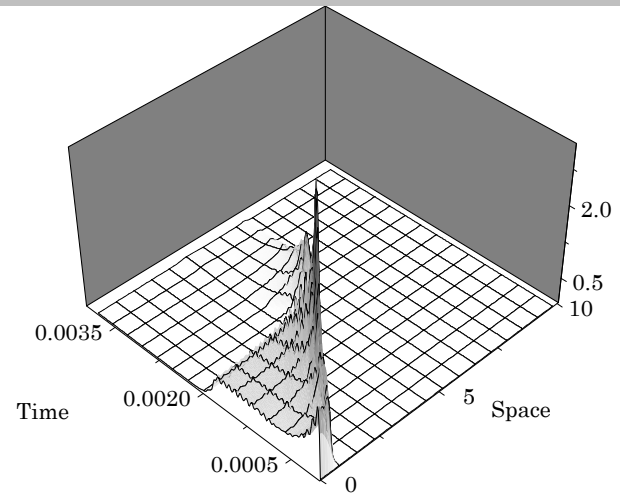


# Healing with RS #1

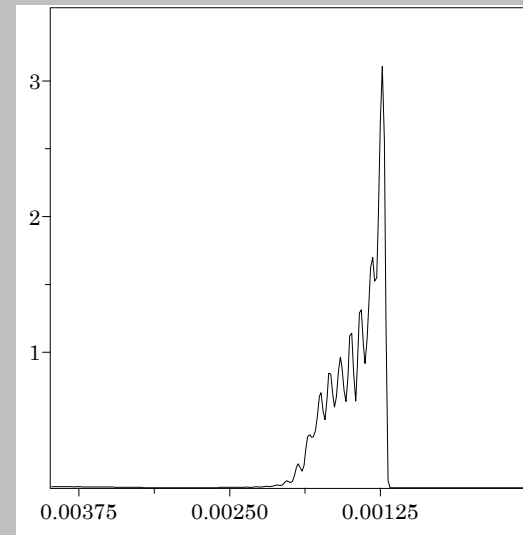
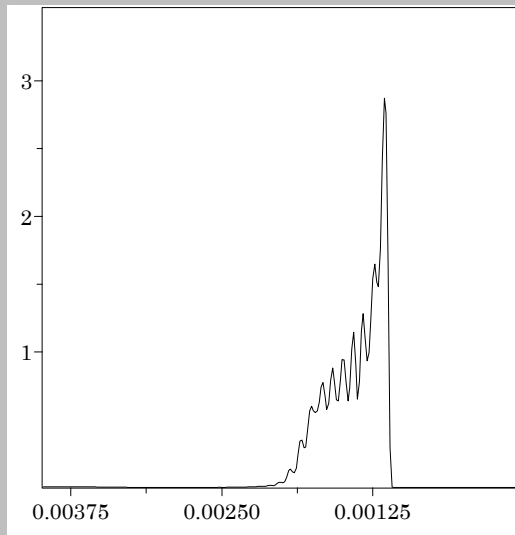
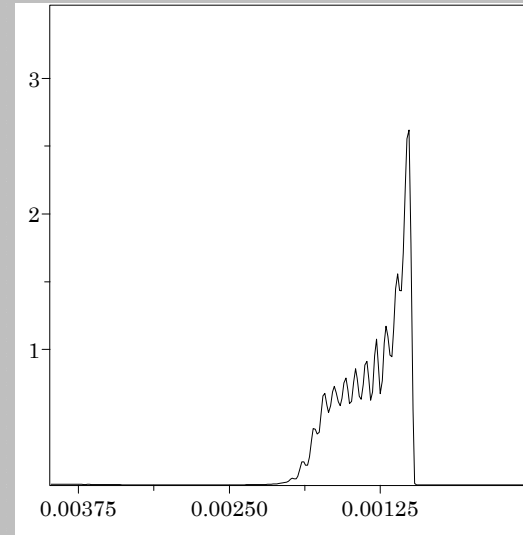
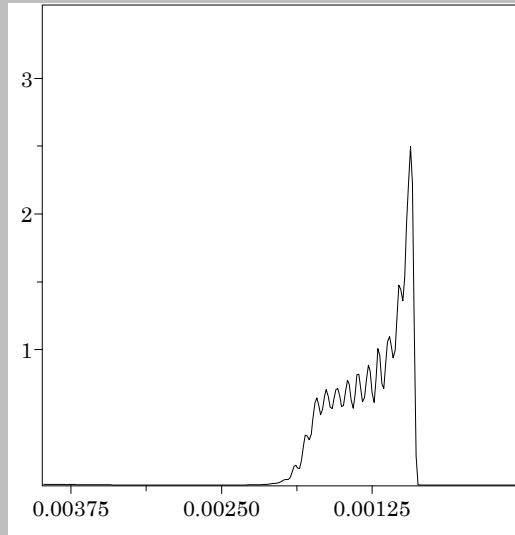
**Barrier – healing:  
heterogeneity of  $L$  parameter**



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



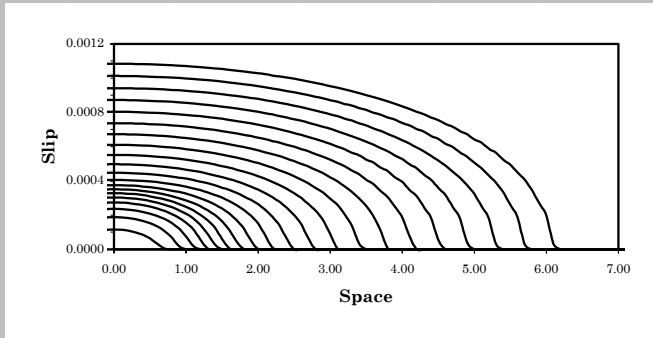
# Healing with RS #2



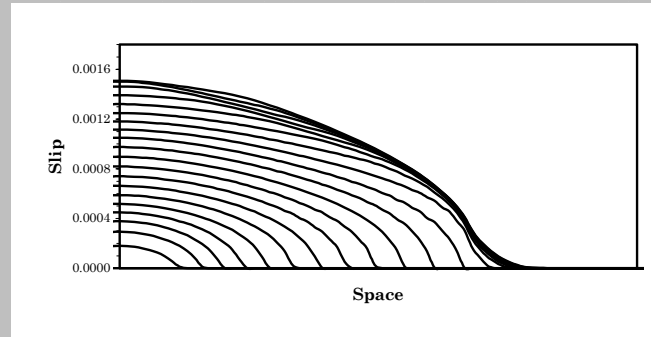


# Healing with RS #3: DRF

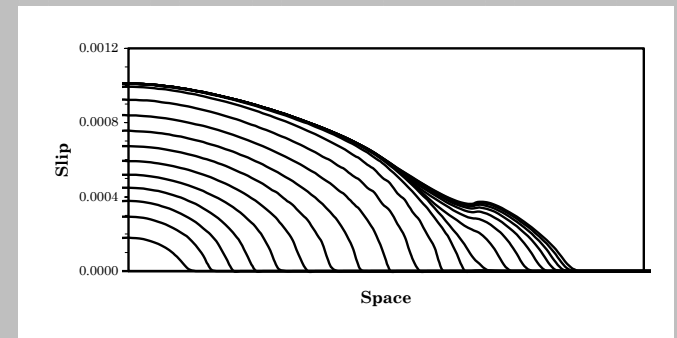
Classical enlarging crack



Barrier - healing



Self - healing

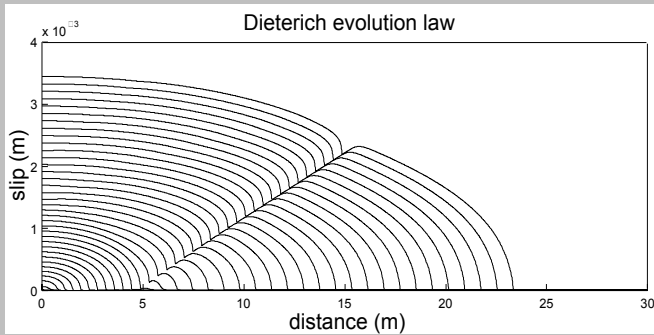




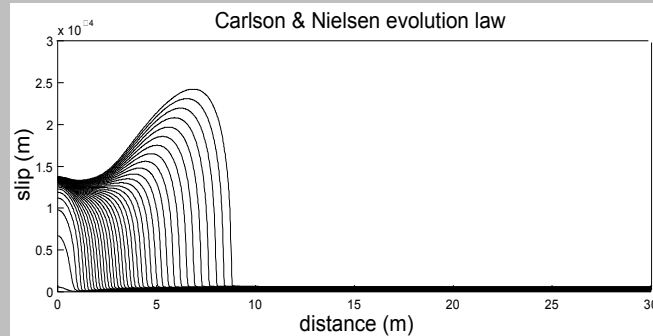


# Healing with RS #4

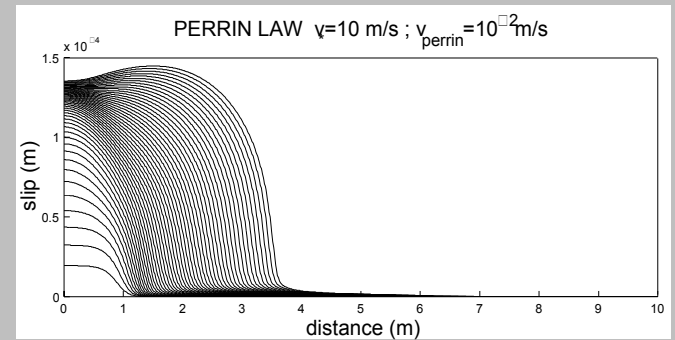
**Classical enlarging crack**



**Self – healing with Carlson's law**



**Self – healing with Perrin's law**



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