Convergence

CONVERGENCE

CONSISTENCY REQUIREMENTS

- As the size of the elements (i. e. the *discretization*) tends to zero, the approximated equations will represent the exact differential equations to be solved and the boundary conditions

STABILITY CONDITIONS

- The solution of the dicrete equation system is unique
- Avoid spurious mechanisms which may pollute the solutions for all sizes of elements

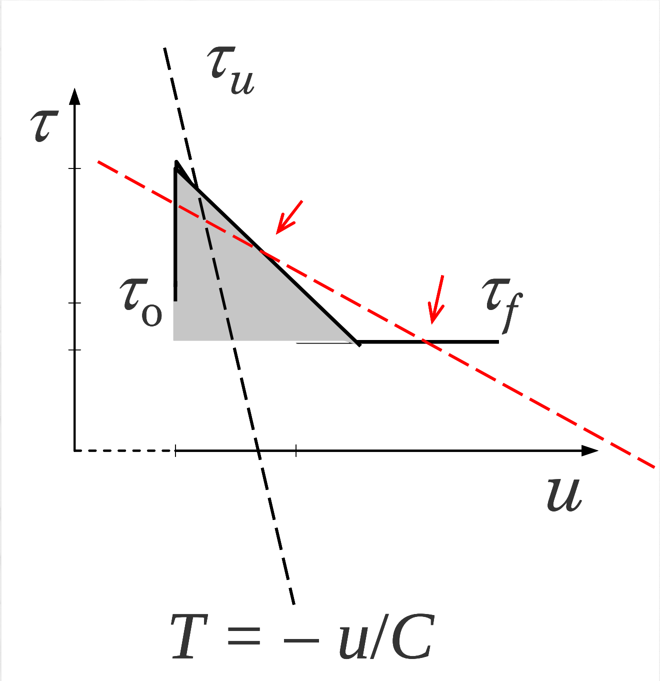
CONVERGENCE

- **How good** the approximation is;
- How can it **systematically improved** to approach the *exact* solution of the problem.

Convergence conditions for BIE with SW constitutive law

Uniqueness of the solution in the integration of linear system (*Andrews*, 1985; B2001)

$$dx < -\frac{v_P\,\mu}{\beta\,\frac{dS}{du}} \quad \Leftrightarrow \quad \frac{L_c^{(II)}}{dx} > \frac{2}{\pi}\,\frac{a-1}{\sqrt{a}}\,(1+S)^2;\; a^2 = \alpha/\beta$$



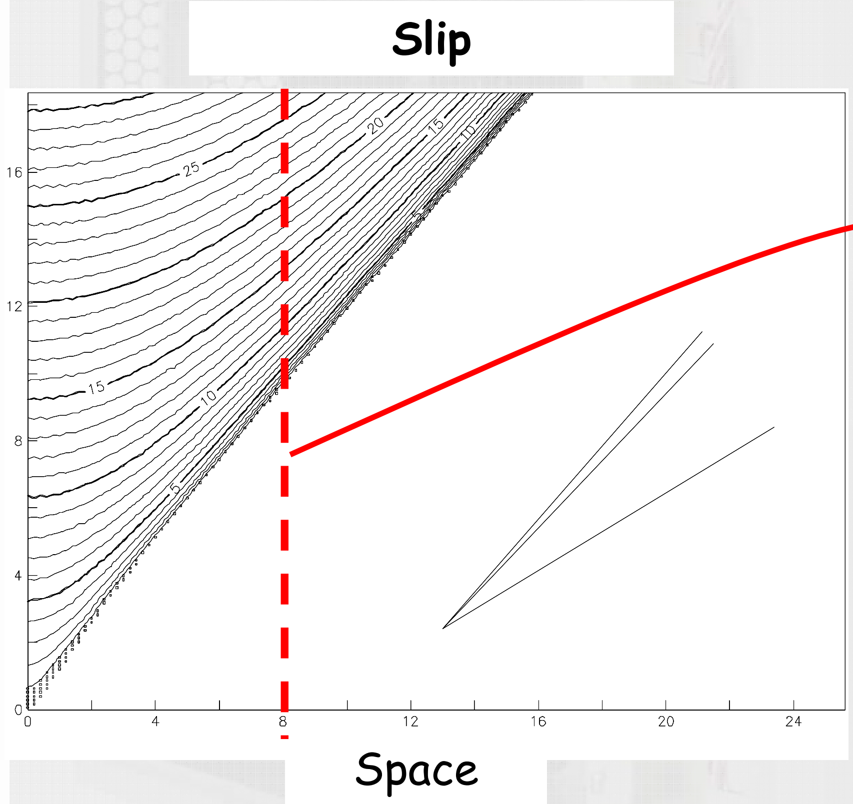
Resolution of the cohesive zone

$$\Delta t \ll T_b \quad \text{or} \quad \Delta x \ll X_b$$

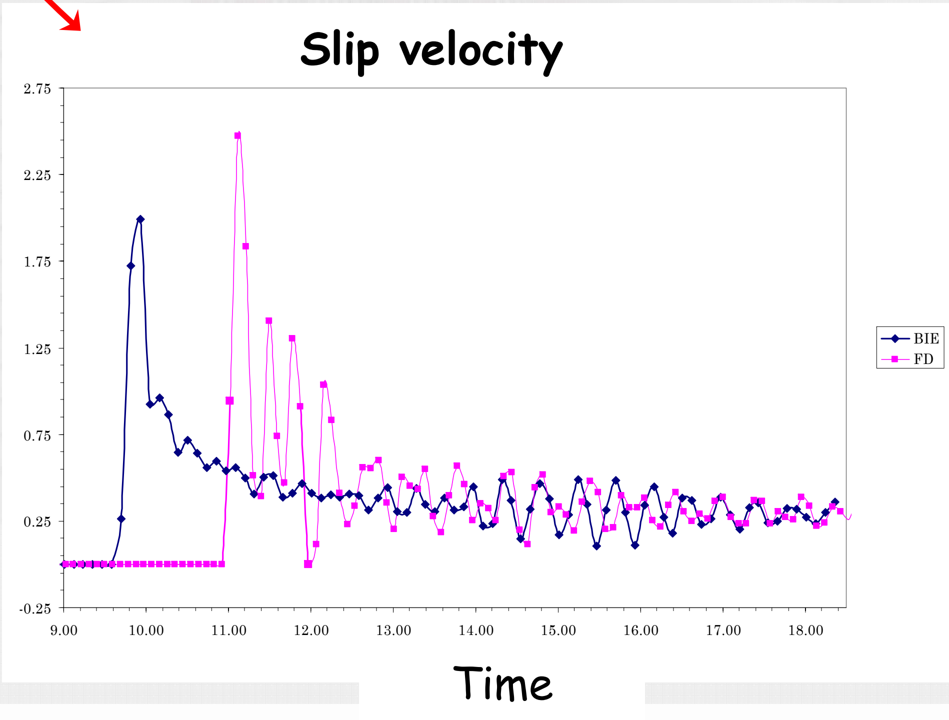
First neighbours decoupling

$$\Delta t \ll \Delta x \,/\, v_P$$

Convergence – Example #1: No resolution of the cohesive zone



BIE and FD 2 – D simulations with the classical slip – weakening law.



Convergence conditions for FD with RS constitutive law

Continuum approximation (*Rice*, 1993)

$k_{diag} >> k_{cr}$ $\Delta t << \Delta t^*$ or $\Delta x << \Delta x^*$

$$\Delta t^* = \frac{v_S \rho L}{(b-a)\sigma_n^{eff}} \quad \text{or, alternatively,} \quad \Delta x^* = \frac{v_S^2 \rho L}{w_{CFL}(b-a)\sigma_n^{eff}}$$

Resolution of the cohesive zone

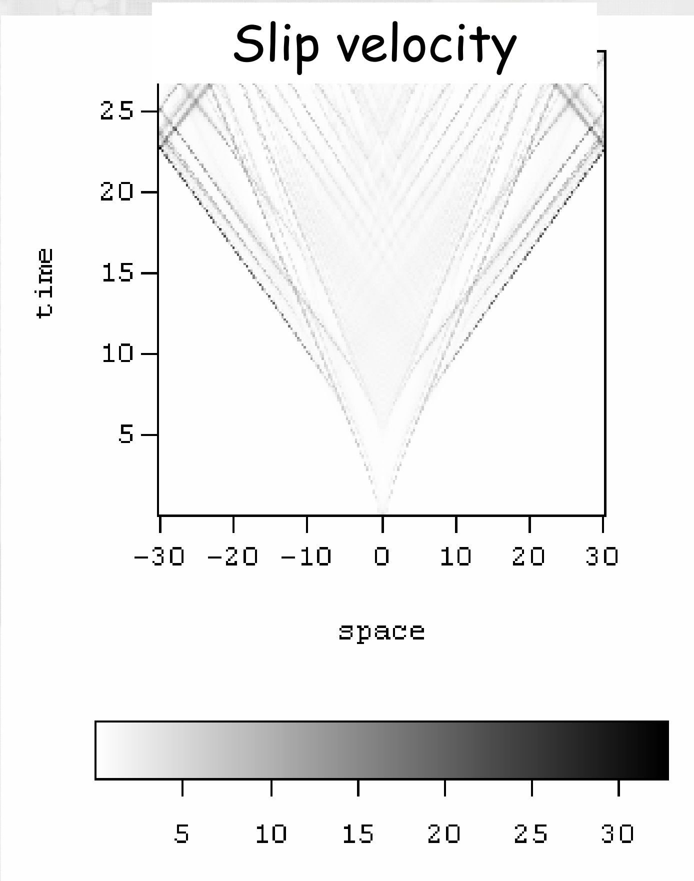
$\Delta t << T_b^{eq}$ or $\Delta x << X_b^{eq}$

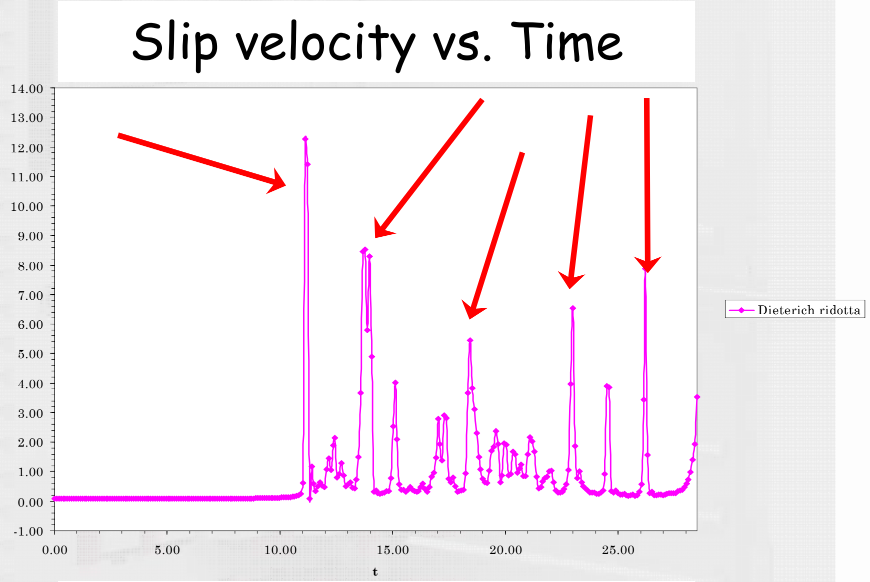
First neighbours decoupling

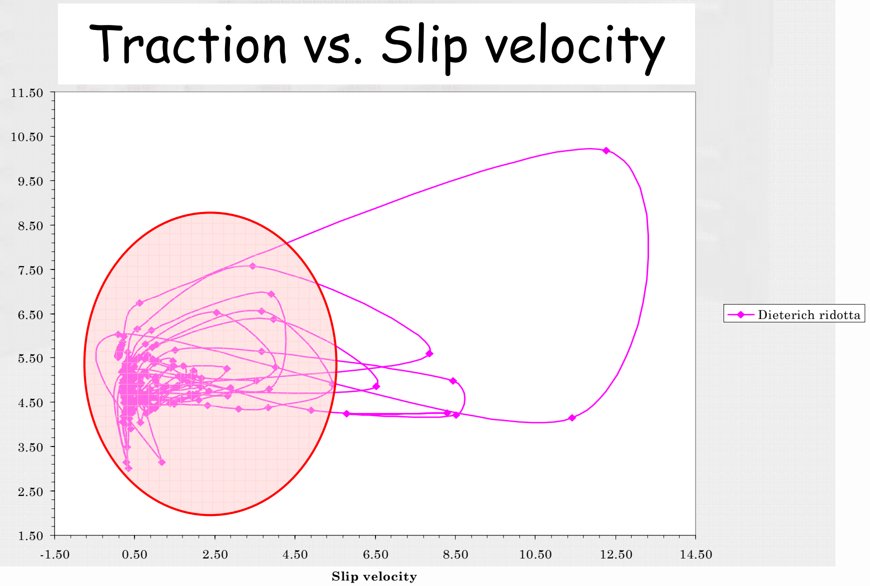
$\Delta t << \Delta x \,/\, v_P$

Convergence – Example #2: Continuum approximation violation

FD 2 – D simulations with Dieterich in reduced form friction law.







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