

An aerial photograph of a coastal wetland. The landscape is a mix of dark, water-saturated mudflats and lighter, sandy or silty areas. A prominent, roughly circular pond is located in the center of the frame. The surrounding terrain shows signs of erosion and sediment deposition, with various textures and colors indicating different soil types and water levels. The overall scene depicts a natural, undisturbed coastal environment.

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 discrete 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)

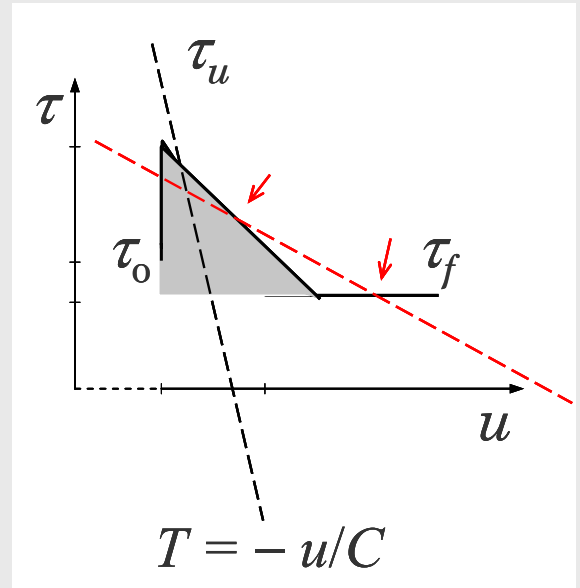
$$\Delta x < -\frac{v_P \mu}{\beta \frac{dS}{du}} \Leftrightarrow \frac{L_c^{(II)}}{\Delta x} > \frac{2}{\pi} \frac{a-1}{\sqrt{a}} (1+S)^2; a^2 = \alpha/\beta$$

Resolution of the cohesive zone

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

First neighbours decoupling

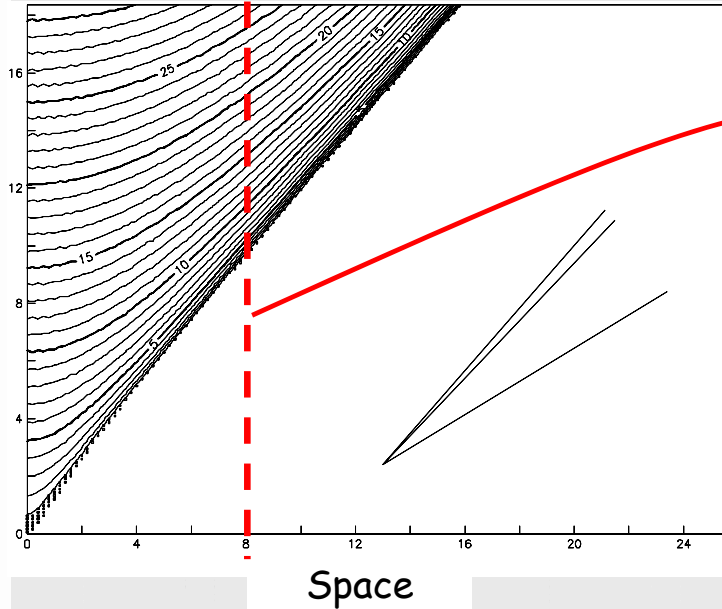
$$\Delta t \ll \Delta x / v_P$$





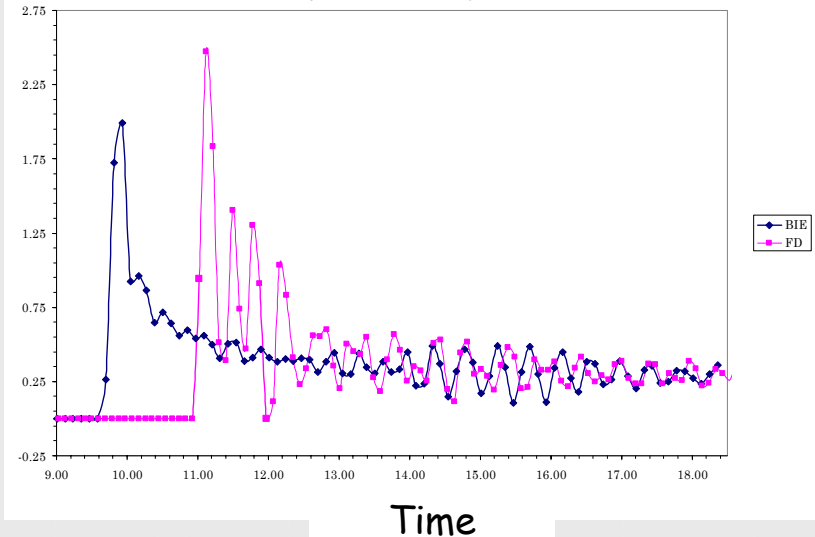
Convergence – Example #1: No resolution of the cohesive zone

Slip



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

Slip velocity





Convergence conditions for FD with RS constitutive law

Continuum approximation (Rice, 1993)

$$k_{diag} \gg k_{cr} \quad \Delta t \ll \Delta t^* \quad \text{or} \quad \Delta x \ll \Delta x^*$$

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

Resolution of the cohesive zone

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

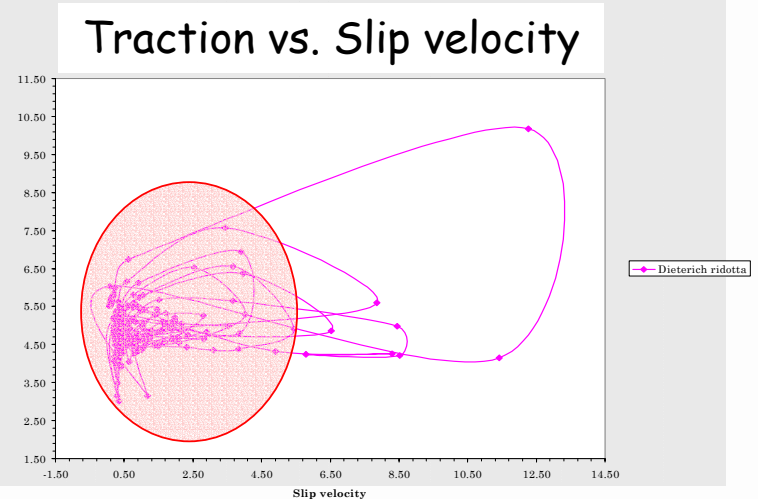
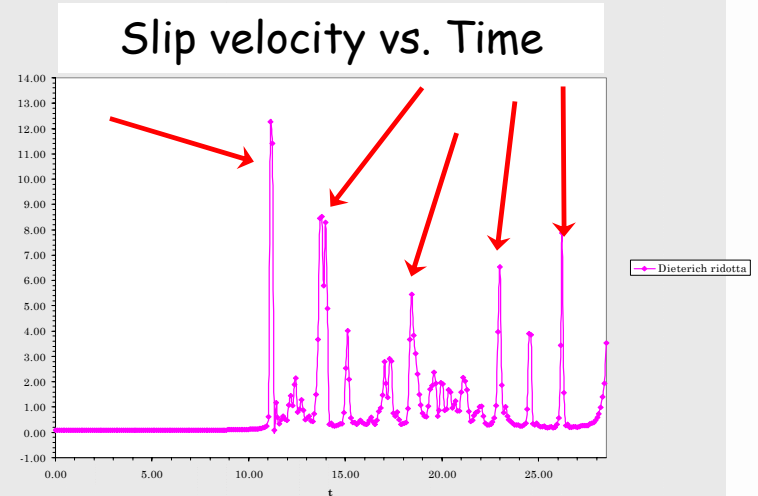
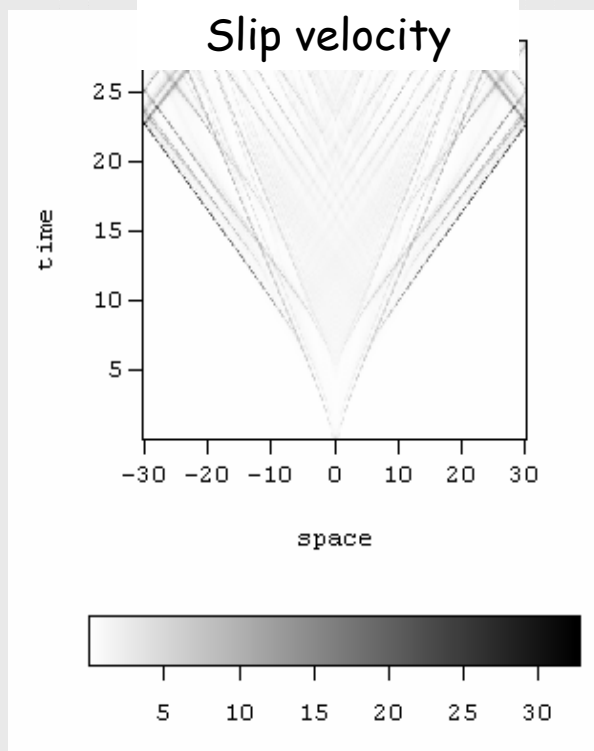
First neighbours decoupling

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



Convergence – Example #2: Continuum approximation violation

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



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