Simulation of waves in nonlinear rocks

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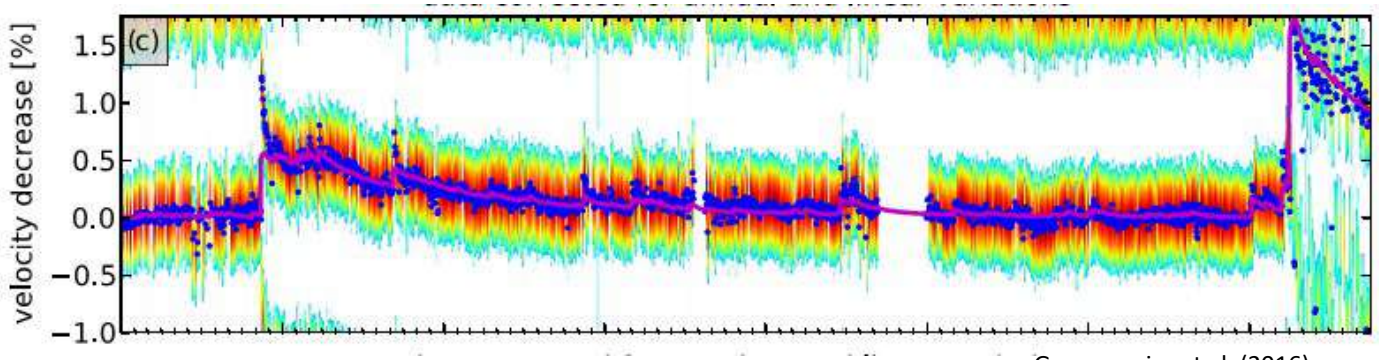


Gassenmeier et al. (2016)

Heiner Igel, LMU

Alice-Agnes Gabriel, LMU/Scripps

Christoph Sens-Schönfelder, GFZ

Sebastian Wolf, TUM

Linus Seelinger, Heidelberg University

Vladimir Lyakhovsky, GSI

Harold Berjamin, UCG

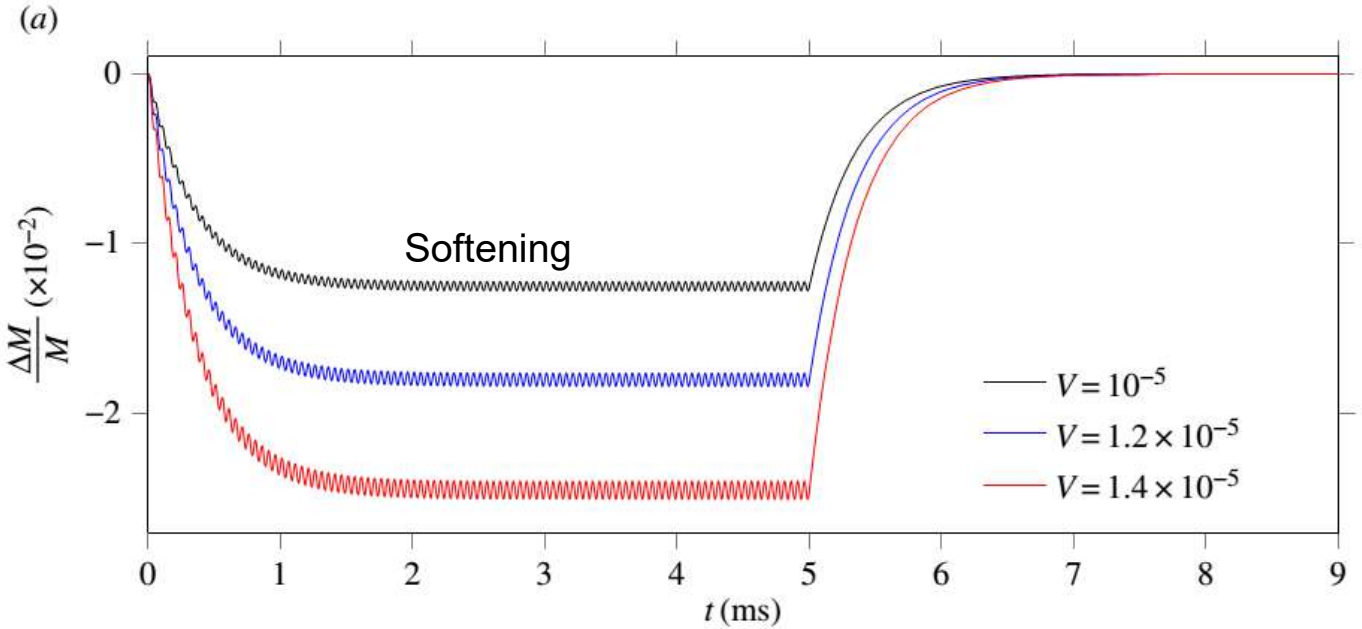
Anne Reinarz, UoD

Model B

Berjamin et al. (2017)

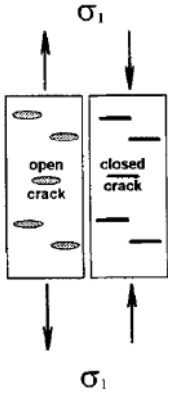
$$e = W\left(\underline{\underline{\varepsilon}}, \alpha\right) = (1-\alpha) W^{e}\left(\underline{\underline{\varepsilon}}\right) + \phi(\alpha)$$

$$\phi(\alpha) = \frac{1}{2}\gamma\alpha^{2}$$



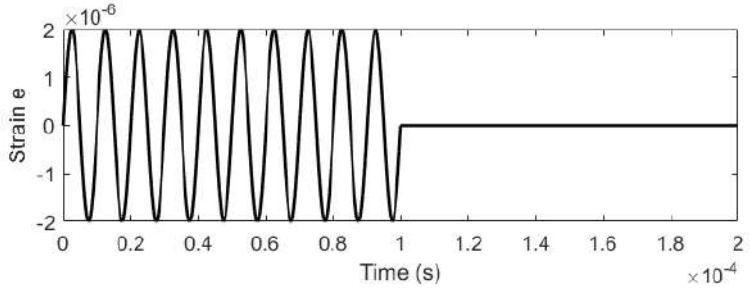
Model L

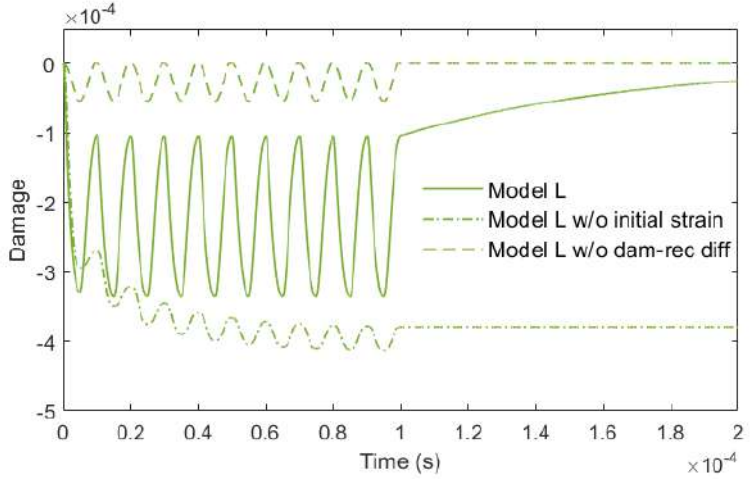
Lyakhovsky et al. (1997)



$$\dot{\alpha} = C\gamma_r \left(I_1 \sqrt{I_2} + \xi_0 I_2 \right)$$

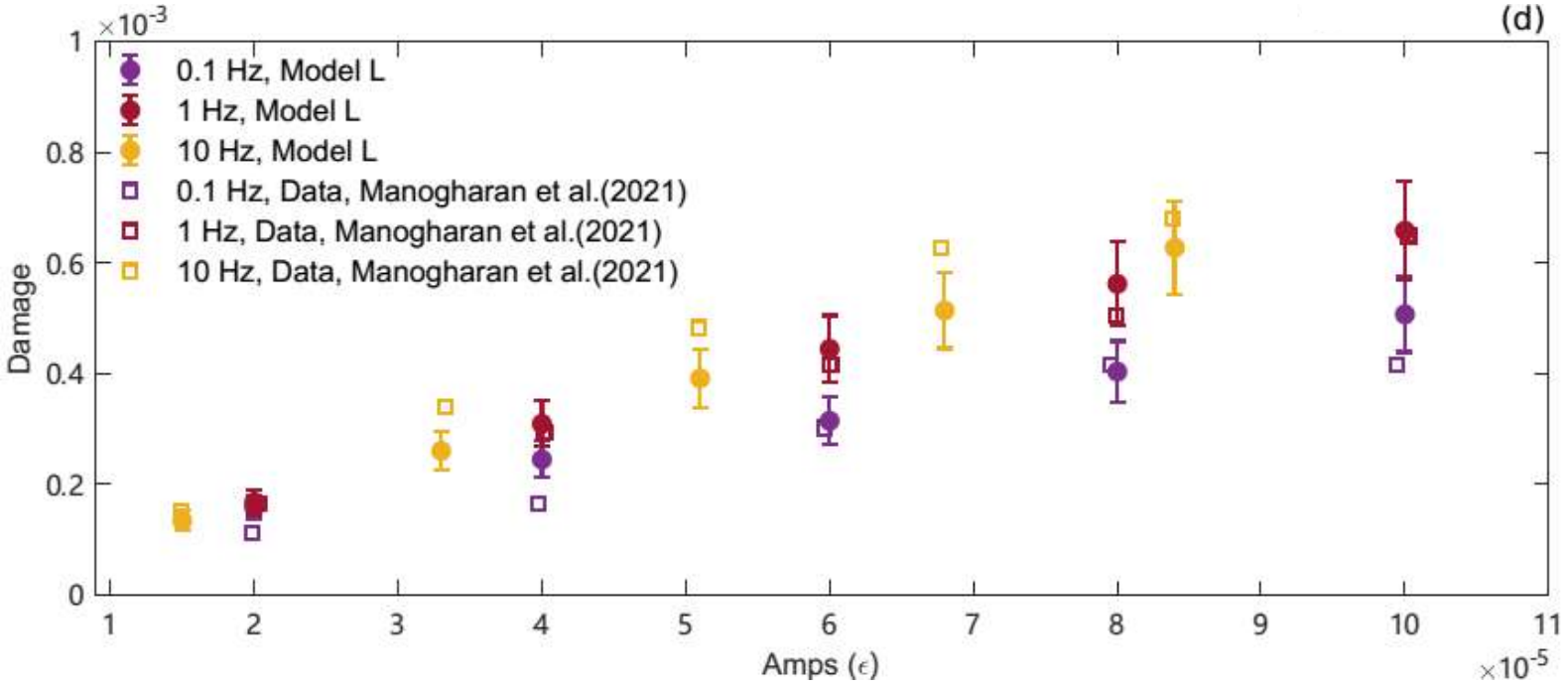
$$= \begin{cases} C_d \gamma_r I_2 \left(\xi + \xi_0 \right) , \alpha > 0 \text{ and } \xi + \xi_0 > 0 \\ C_r \gamma_r I_2 \left(\xi + \xi_0 \right) , \alpha > 0 \text{ and } \xi + \xi_0 < 0 \\ 0 , \alpha \le 0 \end{cases}$$





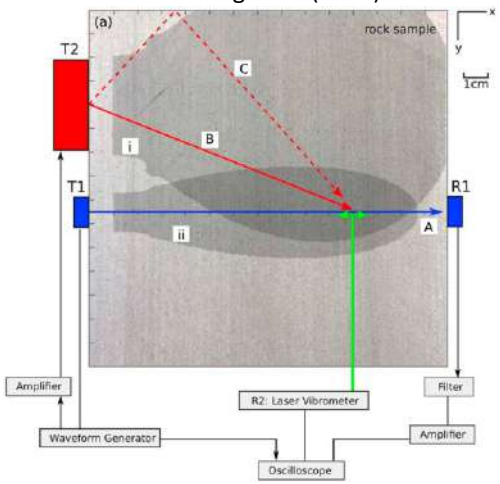
Experiment 1

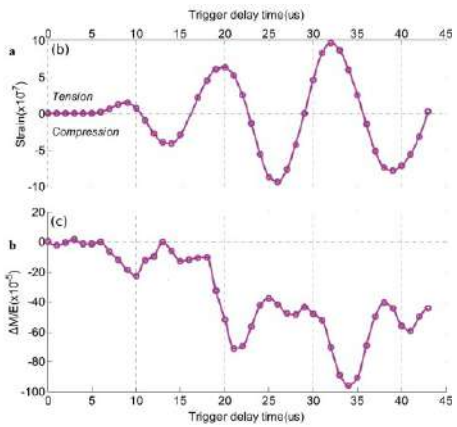
- **Amplitude and frequency dependent damage**

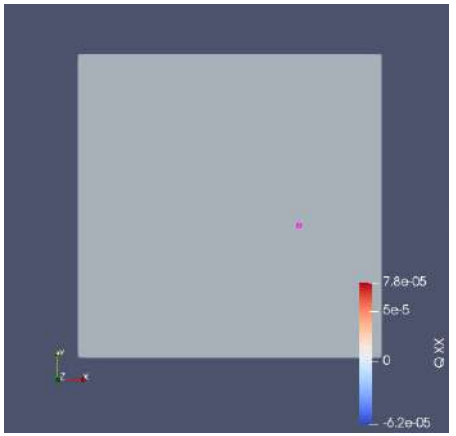


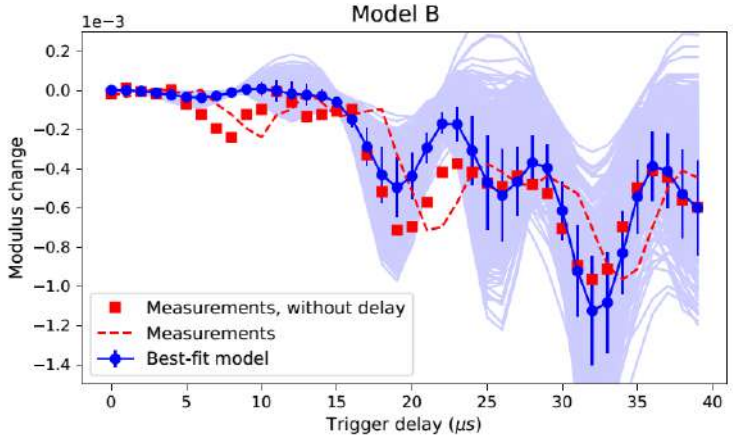
Experiment 2

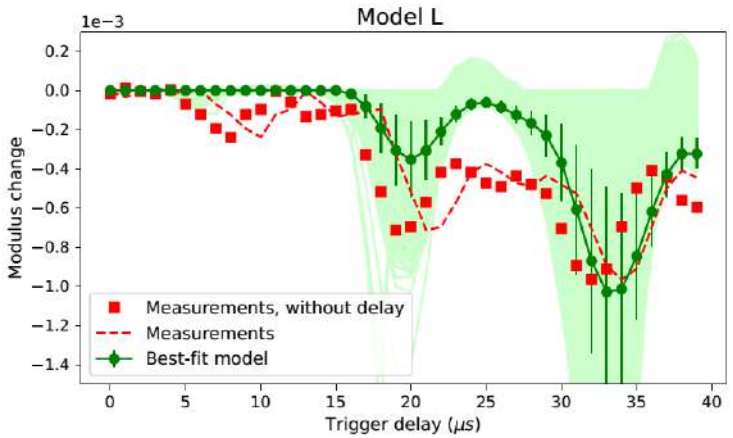
Feng et al. (2018)





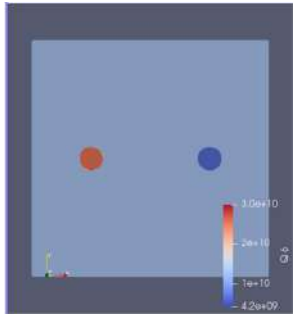


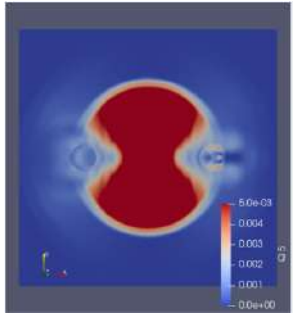




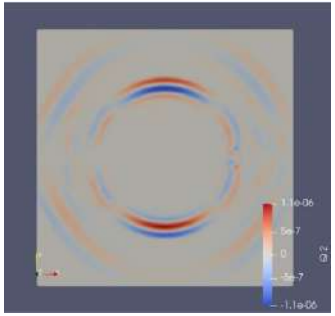
Simulation with more complexities

- 2D with heterogeneities



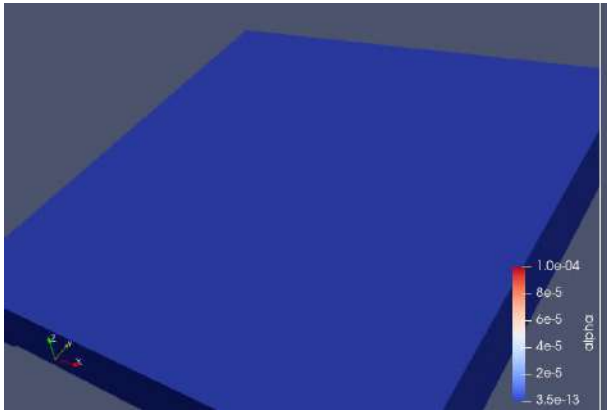


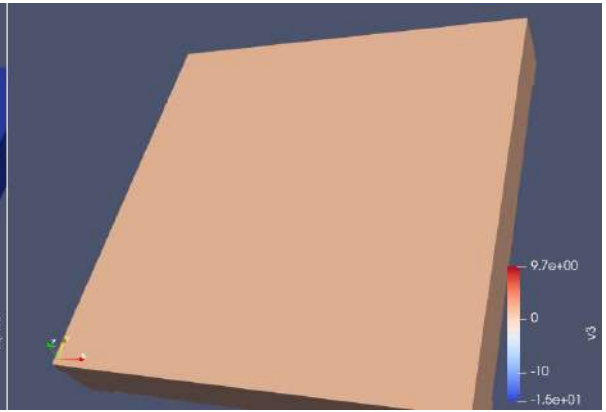
Damage

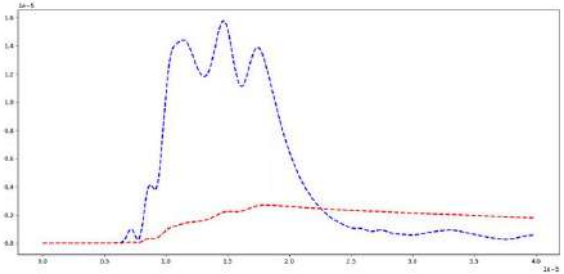


Velocity

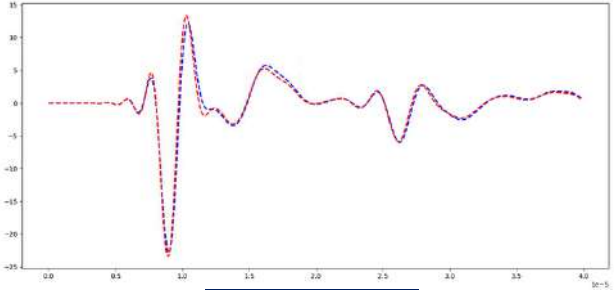
- 3D simulation in SeisSol







Damage



Velocity

Concluding remarks

- Solvers from 1D to 3D, with possibilities of modeling heterogeneities and topography.
- Scattered wavefield in heterogeneous media with damage rheology?
- Explain some aspects of the observed velocity drop in the field with 3D simulation?