



Bias restrictions for the MRE nonlinear inversion problem

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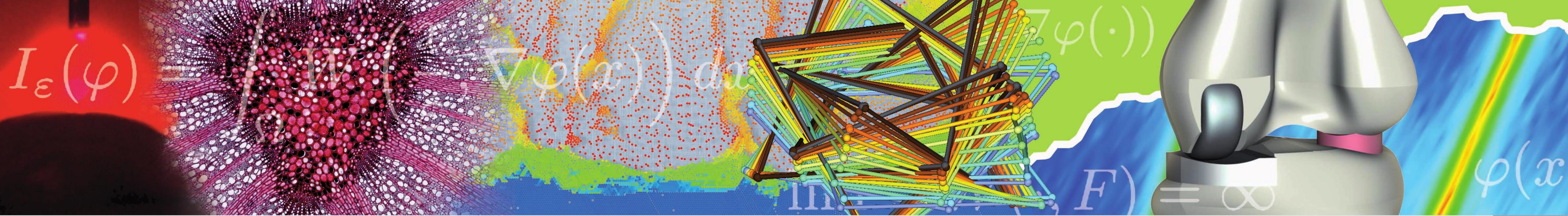
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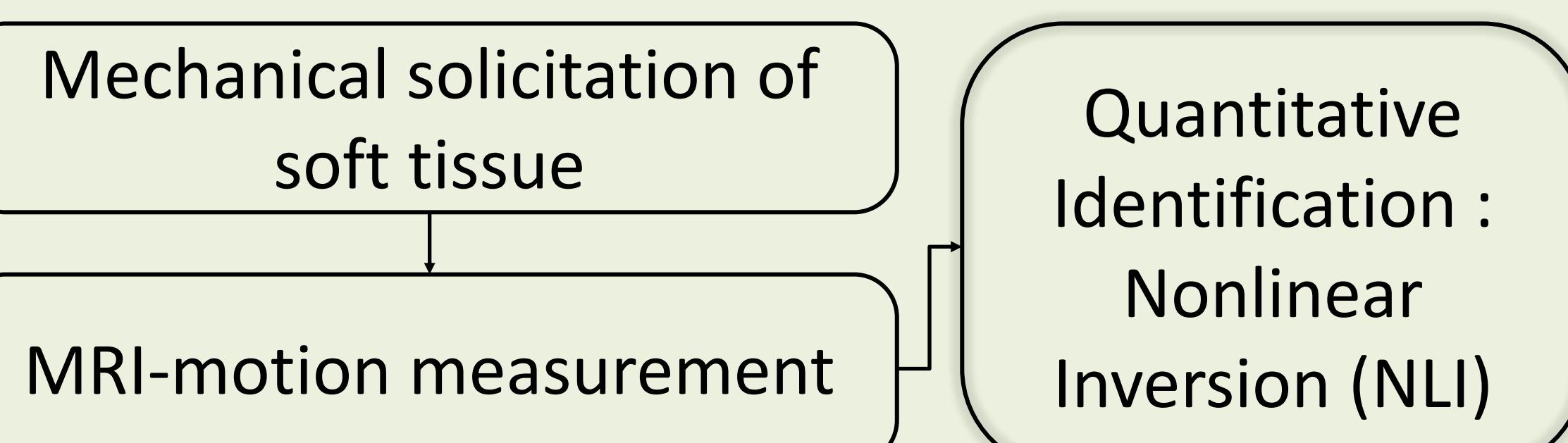


Bias restrictions for the MRE nonlinear inversion problem

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Context

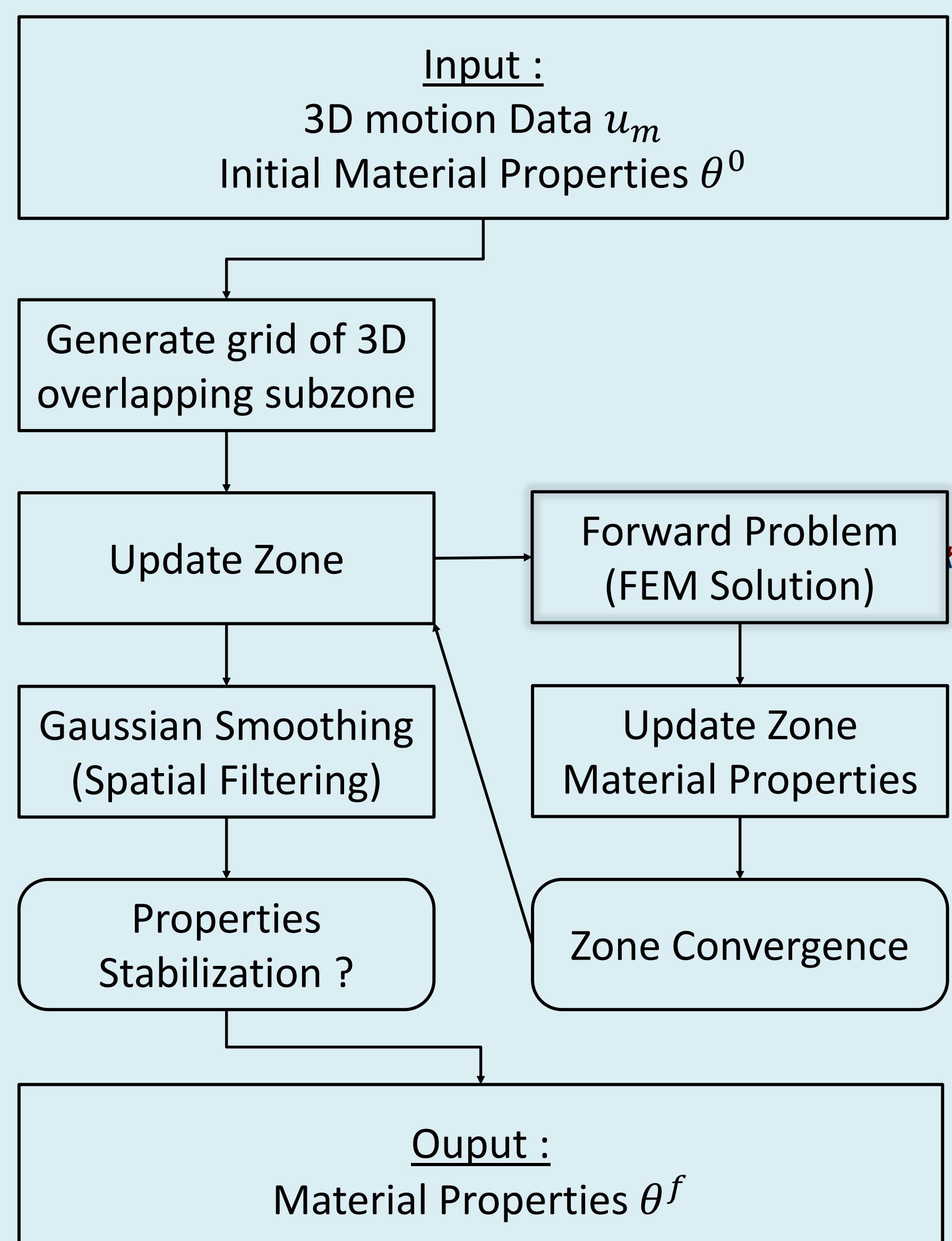
Identification problem :

- 3D with subzone decomposition
- Viscoelastic, isotropic $\rightarrow \mu, \xi$
- Harmonic (single frequency)

Main limitations :

- Boundary conditions (BC) estimation (see poster 18 : Wattrisse *et al.*)
- Noise level
- Spatial resolution
- Low signal-to-noise regions

“No-BC” NLI Subzone Algorithm



Method

u-BC method

Kinematical error strayed in $\{U\}$

$$\begin{cases} [K(\theta^i)]\{U^i\} = \{0\} & \text{on } \Omega \\ \{U\} = \{U_m\} & \text{on } \Gamma \end{cases}$$

$$\begin{cases} [K(\theta^i)]\{W^i\} = \{U - U_m\}^H & \text{on } \Omega \\ \{W\} = \{0\} & \text{on } \Gamma \end{cases}$$

No u-BC method

Kinematical error fully supported by $\{W\}$

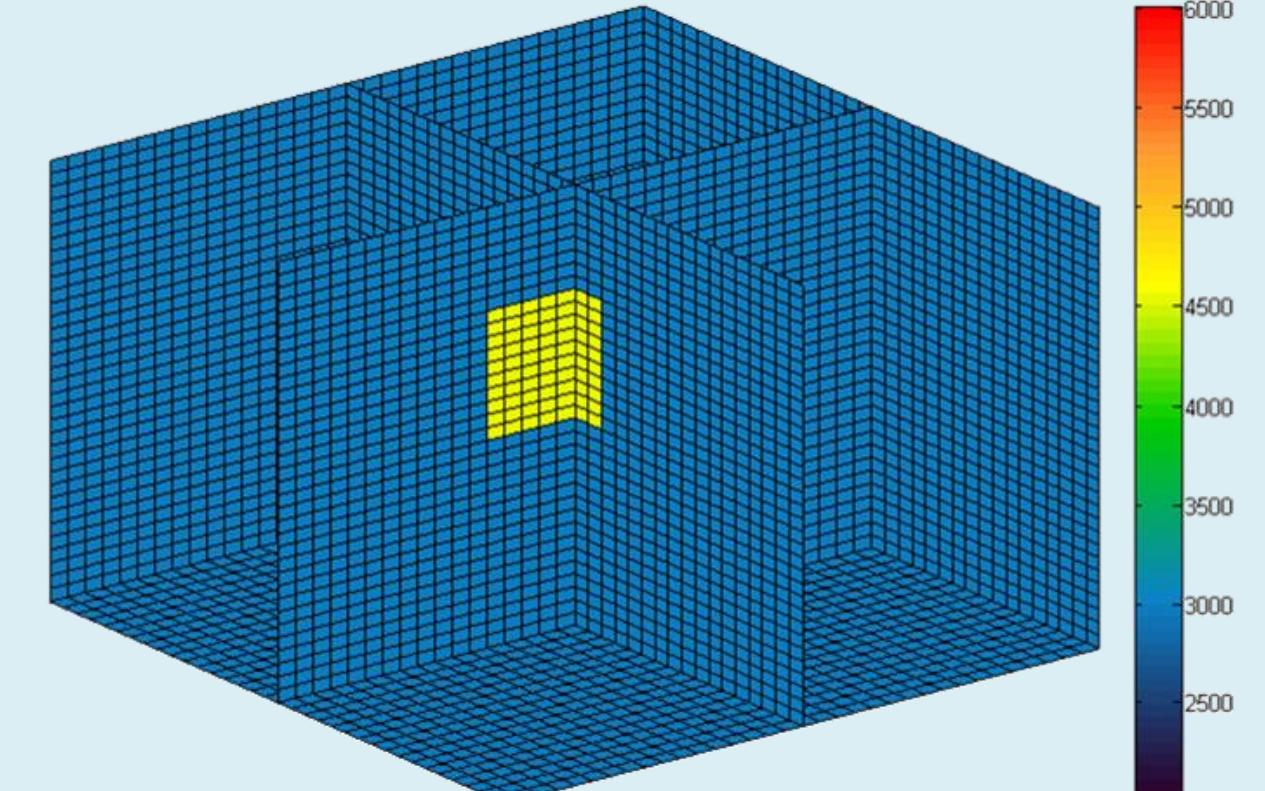
$$\begin{cases} \{U^i\} + [K(\theta^i)]^H\{W^i\} = \{U_m\} & \text{on } \Omega \\ [K(\theta^i)]\{U^i\} = \{0\} & \text{on } \Omega \\ \{W\} = \{0\} & \text{on } \Gamma \end{cases}$$

In-silico validation

Numerical model :

- Linear viscoelastic, nearly incompressible, isotropic material
- Low matrix-inclusion properties contrast
- Pure shear solicitation

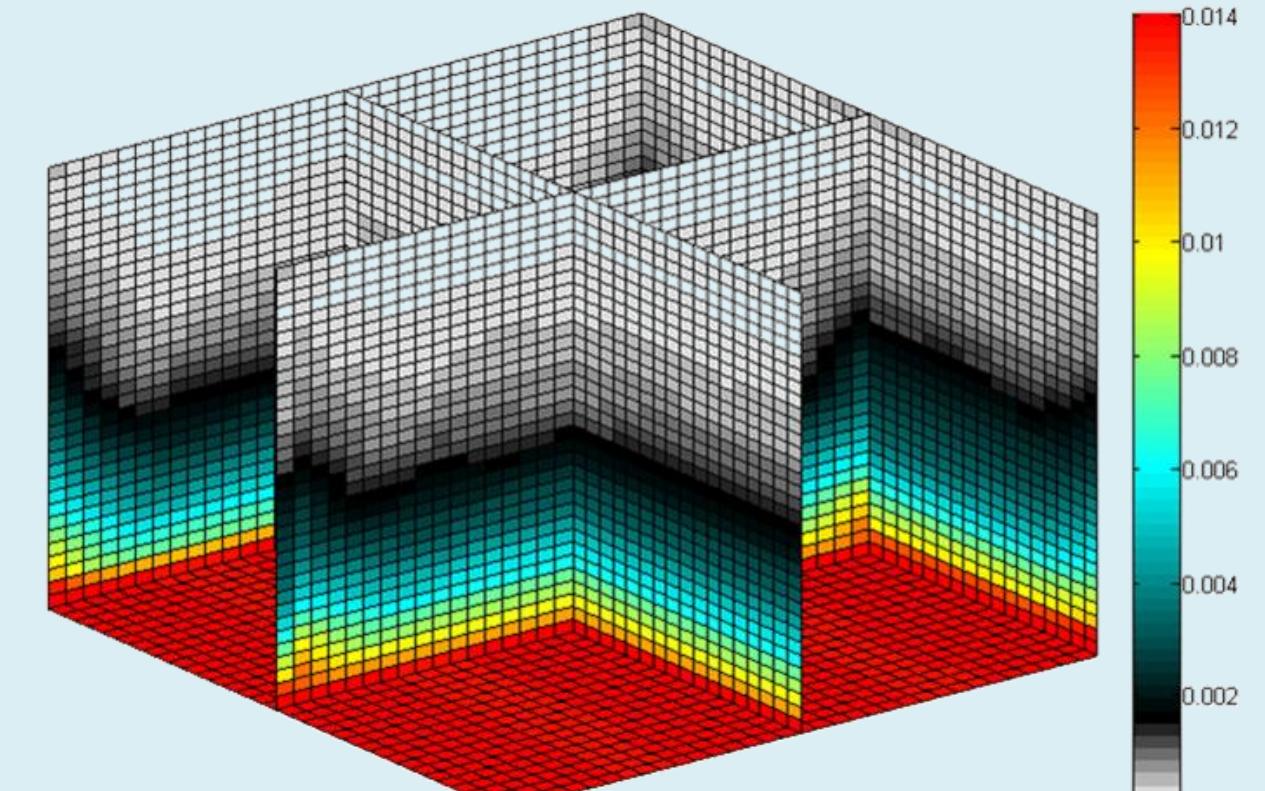
Model μ_{ref} [Pa]



Process :

- Interpolation onto a coarser mesh
- Corruption by a random isotropic gaussian noise
- Several noise instances

Unoised octahedral shear strain



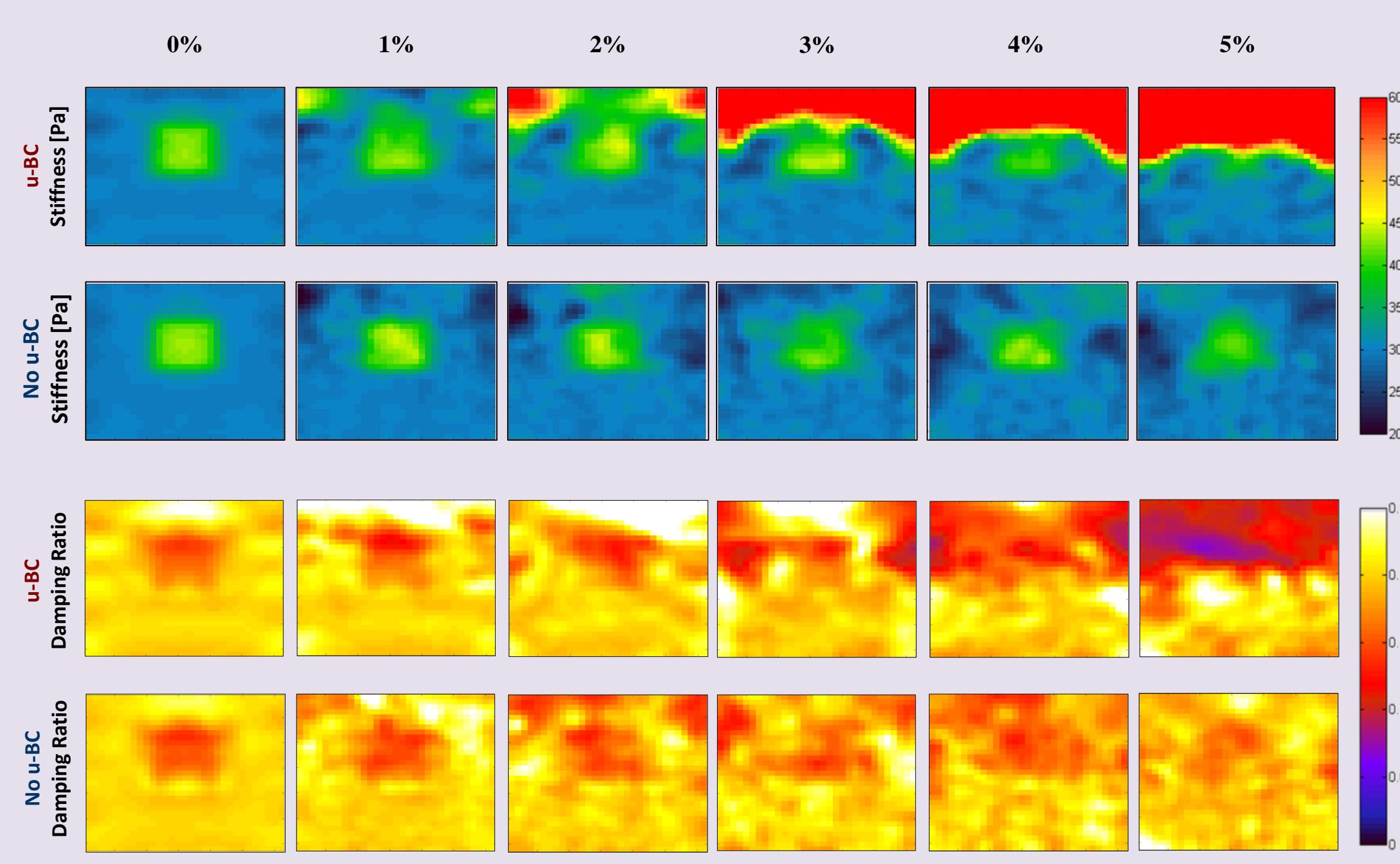
Driving parameters :

- Signal-to-noise ratio SNR_m

- Initial moduli μ_0, ξ_0
- Wavelength - Subzone length ratio λ/L_z

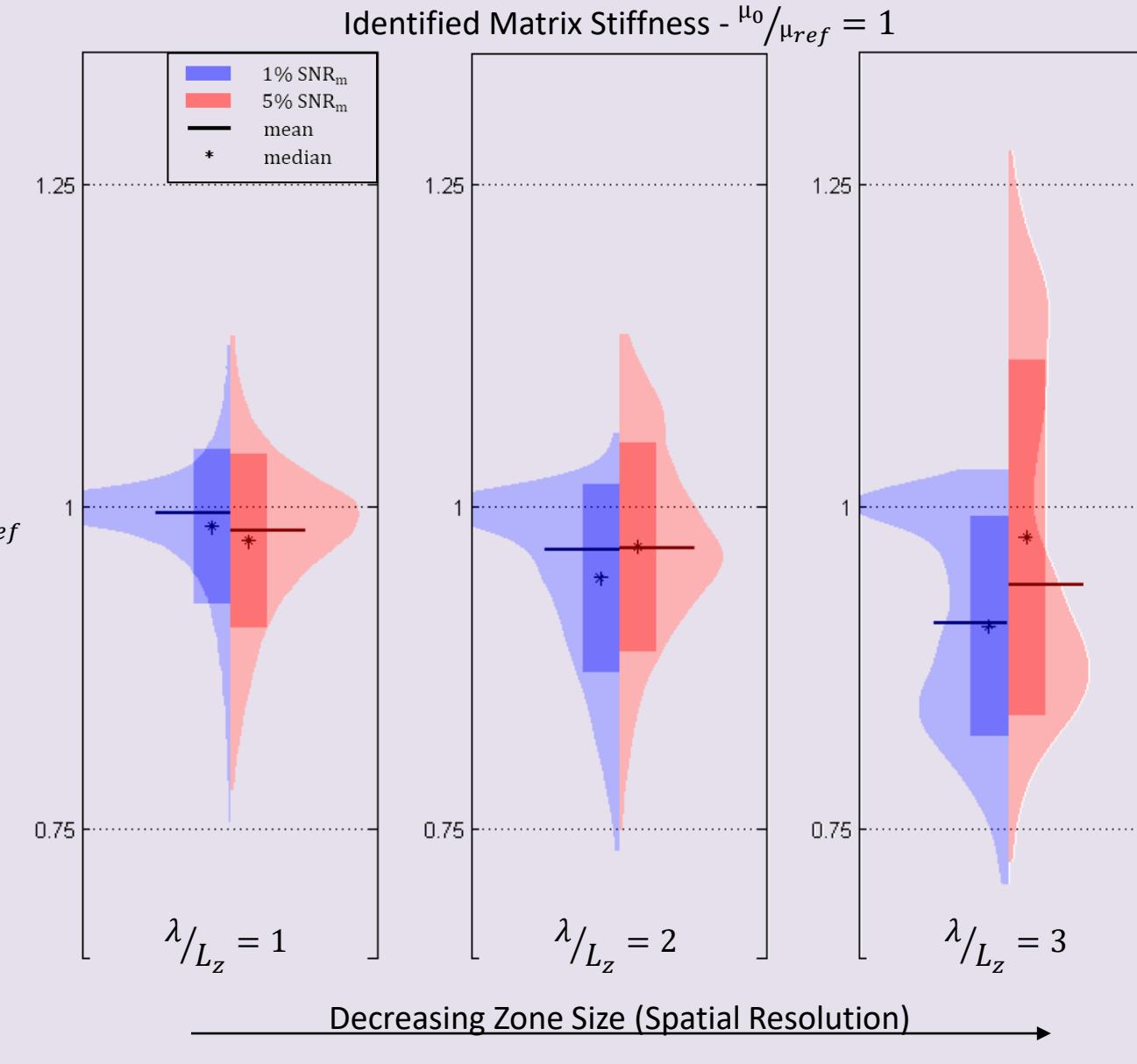
Results

• u-BC / No u-BC comparison : impact of SNR_m



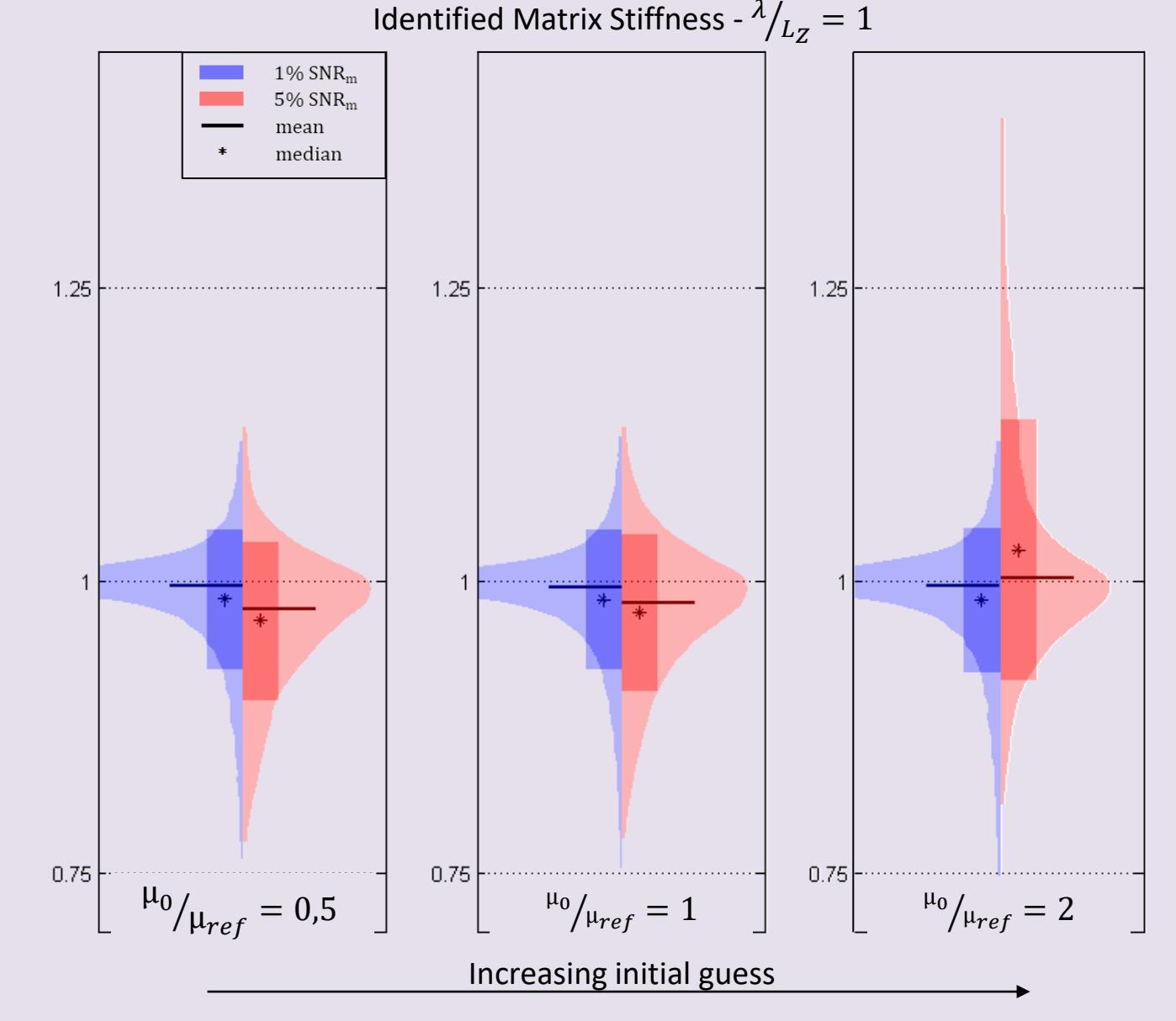
- No u-BC limits hot spots due to low-signal
- Slightly decrease of global stiffness

• No u-BC : impact of L_z



- SNR impact is consistent to initial guess
- Several populations appears for bad resolution cases
- Decrease of stiffness with resolution

• No u-BC : impact of initial guess μ_0



- Steady results for low SNR
- A single population observed
- High initial guess generates hot spots

