AdMoRe

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Advanced Physics-Based and Data-Driven Strategies

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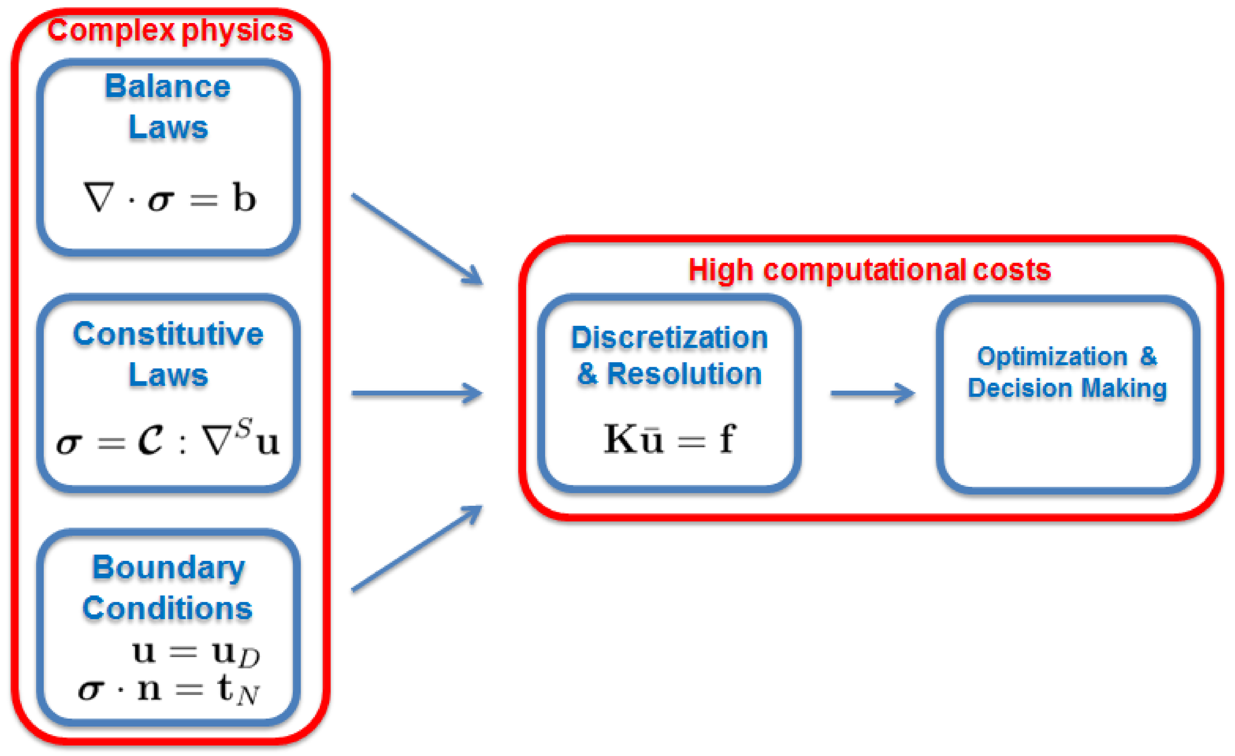
CONCLUSIONS

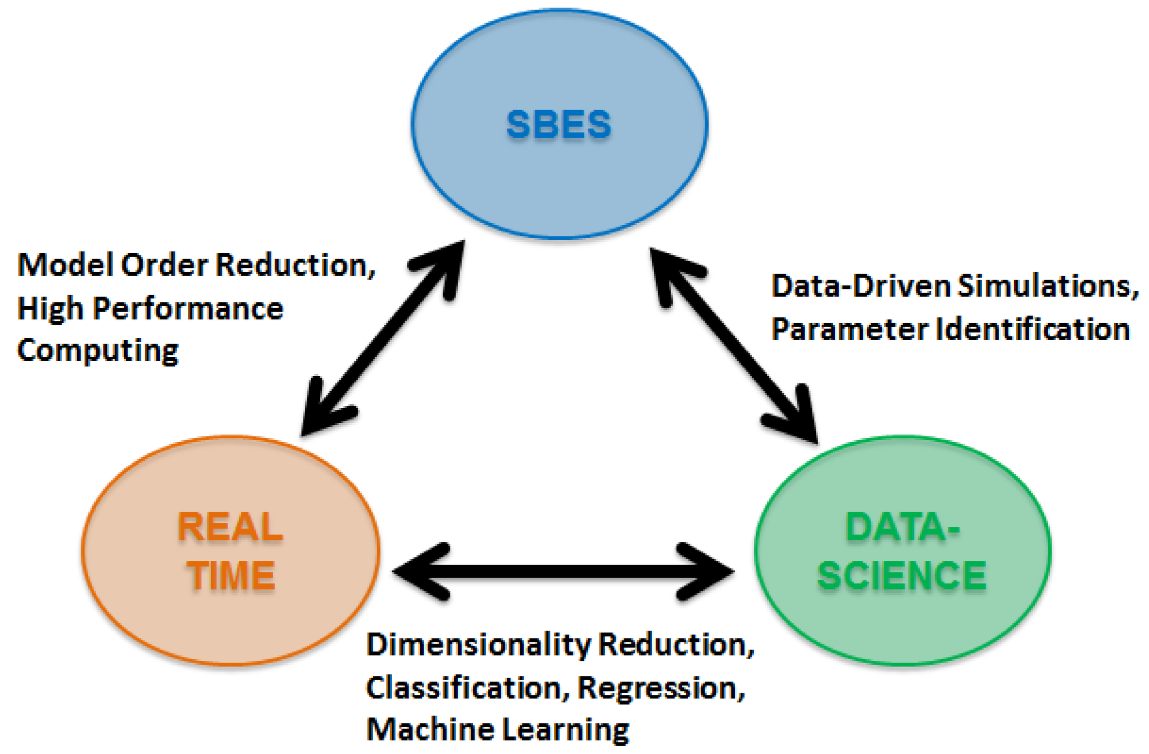
We strongly believe that our **contributions pointed to** the fulfillment of the so-called **Dynamic Data Driven Application Systems (DDDAS)** paradigm, still in its **early stage development**.

1. PROBLEM STATEMENT

The objective is to alleviate high computational costs due to complex physics appearing in Simulation Based Engineering Science (SBES).
DDAS seeks to solve that problematic by combining SBES techniques together with Data-Science and Real-Time.



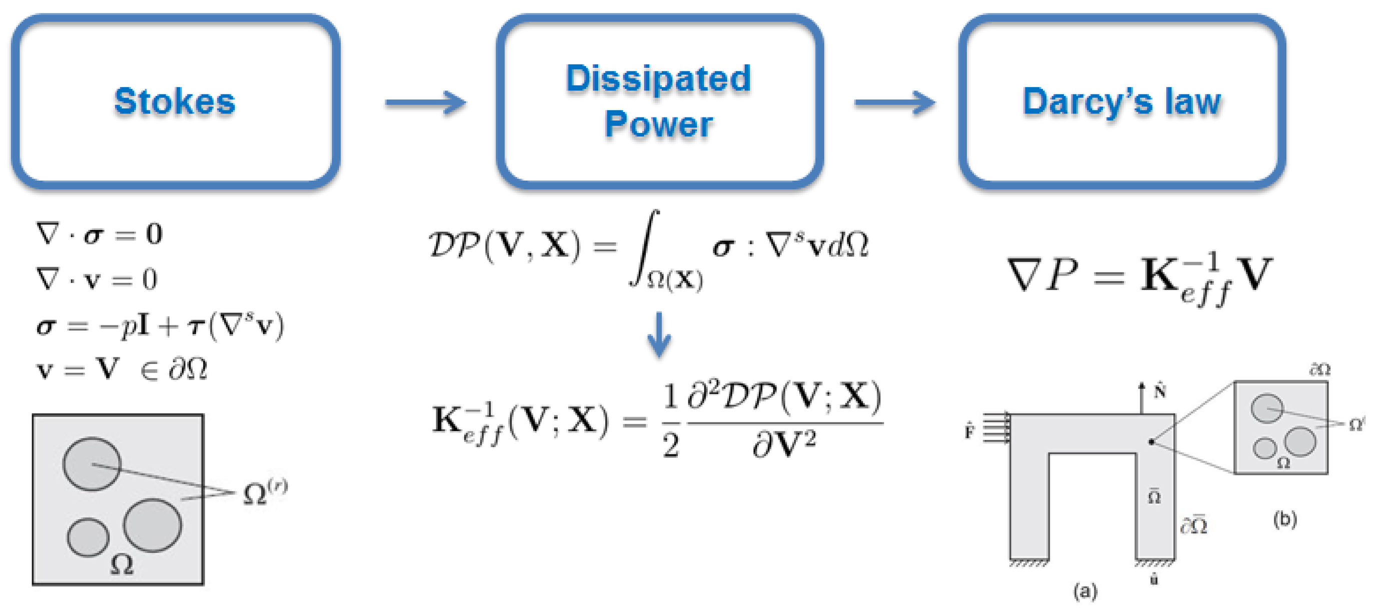
Bottlenecks SBES

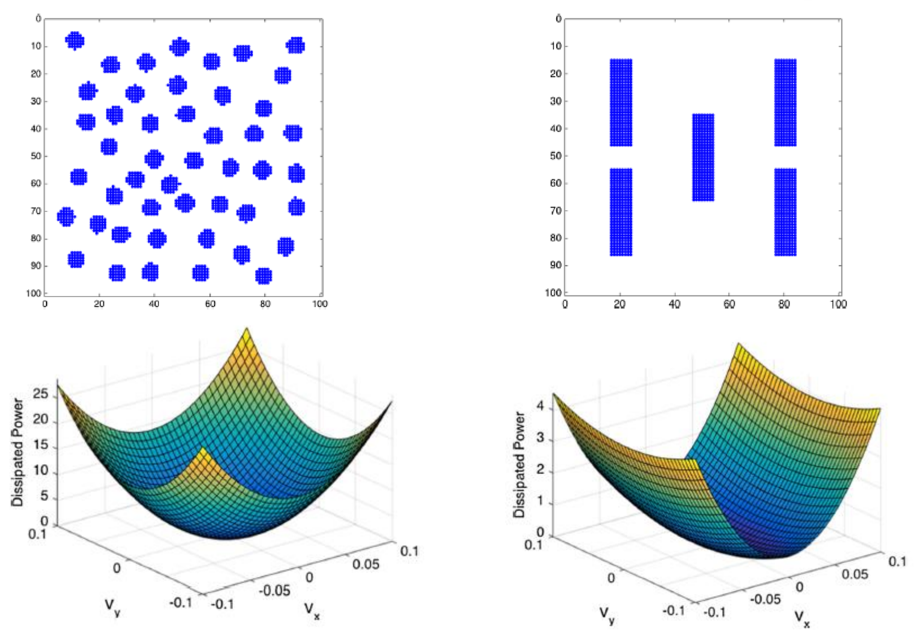


DDAS Building Blocks

2. DATA-DRIVEN

An effective macro Darcy's behavior is obtained from a Stokes flow in the micro scale, thanks to the preservation of the dissipated power.

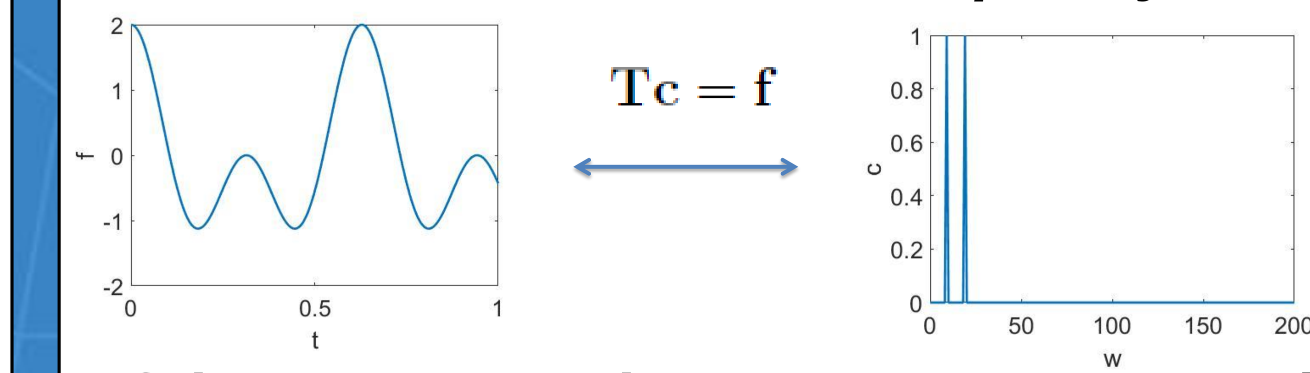




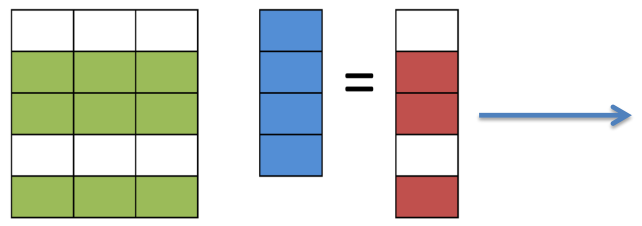
$$\mathbf{K}_{iso} = \begin{pmatrix} 3.55e-4 & 0 \\ 0 & 3.62e-4 \end{pmatrix} \quad \mathbf{K}_{ortho} = \begin{pmatrix} 1.29e-3 & 0 \\ 0 & 7.77e-3 \end{pmatrix}$$

3. DATA COMPLETION

Compressed Sensing (CS) could be of crucial importance within DDAS, as it allows to complete data efficiently.

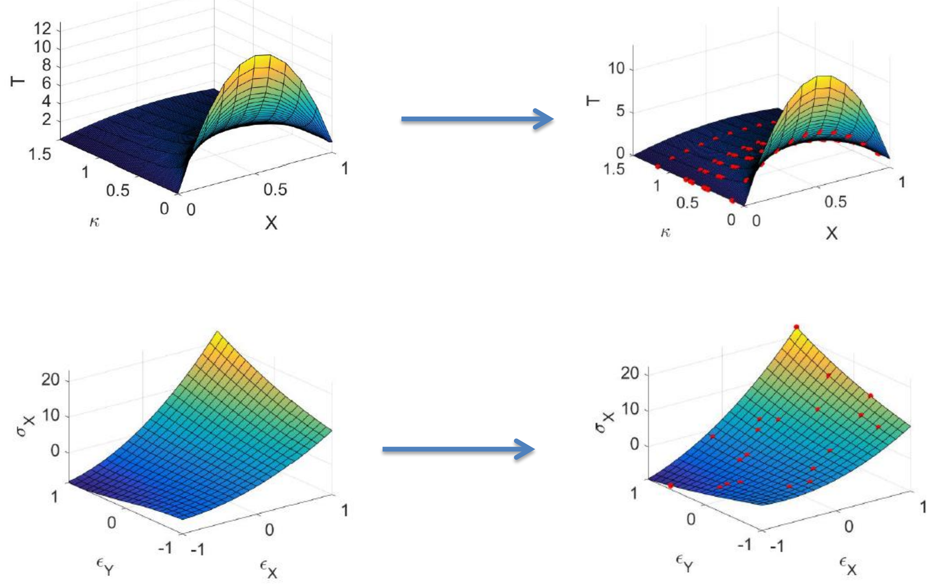


If the new space is sparse, LASSO regularization can be used to reconstruct the solution.



$$\min_{\mathbf{c}} (||\mathbf{ETc} - \mathbf{Ef}||_{L2}^2 + \lambda ||\mathbf{c}||_{L1})$$

CS used to reconstruct parametric and constitutive relationships.



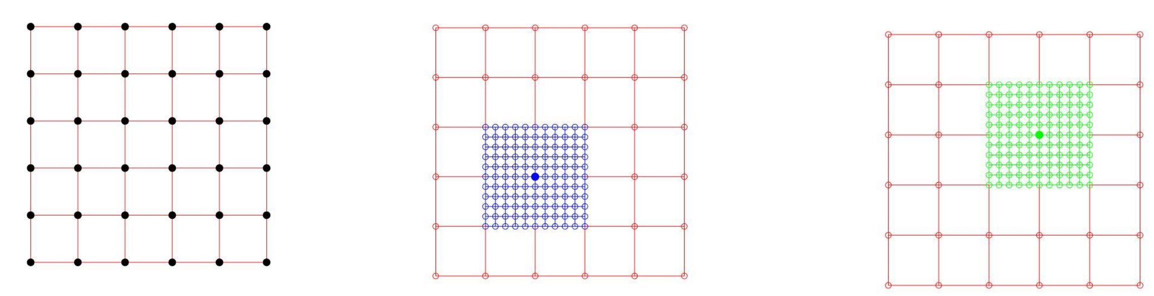
4. MODEL ORDER REDUCTION

Separability of standard PGD in enhanced due to the partition of unity (PU)

Multi-PGD formulation

$$u(x,y) = \sum_{i \in \mathcal{I}} N_i(x,y) \sum_{k=1}^{M} X_k^i(x) Y_k^i(y)$$

Macro Partition

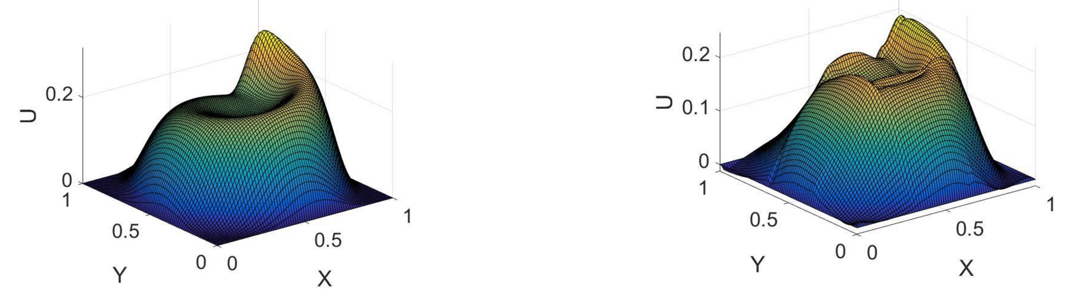


Advantages:

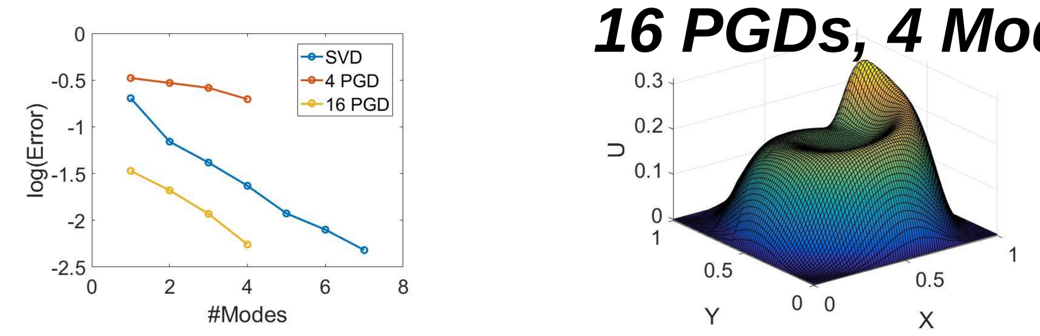
- *Less number of modes*
- *Continuity satisfied*

Convection-Reaction-Diffusion Problem

Reference / ***4 PGDs, 4 Modes***



16 PGDs, 4 Modes



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[2] F. Darema, "Dynamic Data Driven Applications Systems: A New Paradigm for Application Simulations and Measurements. Computational Science." Int. Conf. on Computational Science (ICCS), LNCS, 3038, 662–669, 2004.