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de BORDEAUX

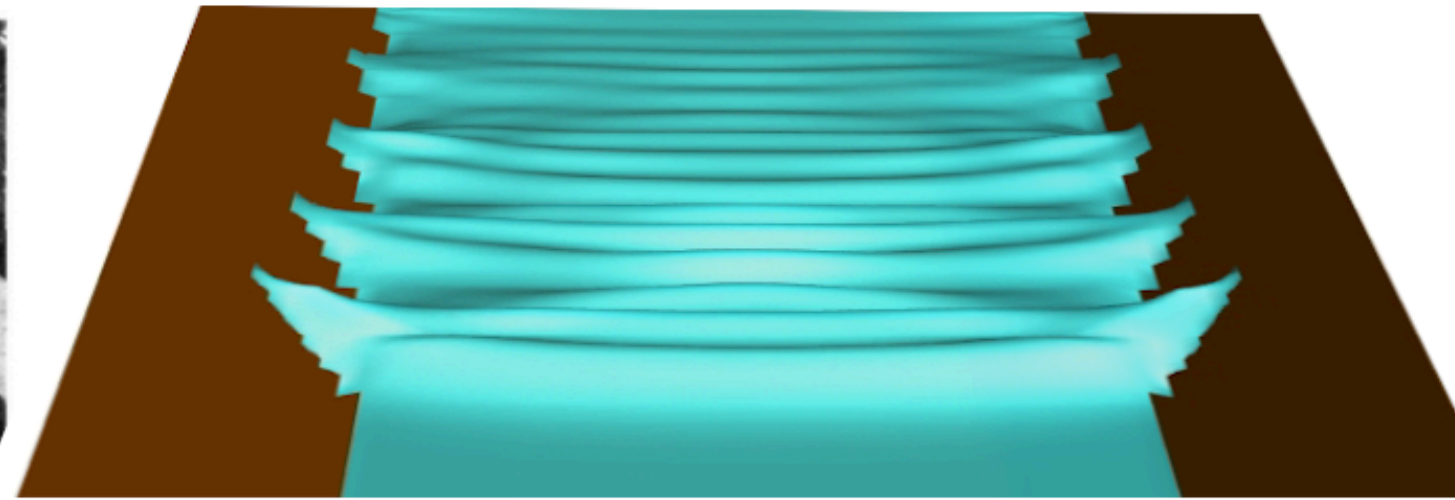
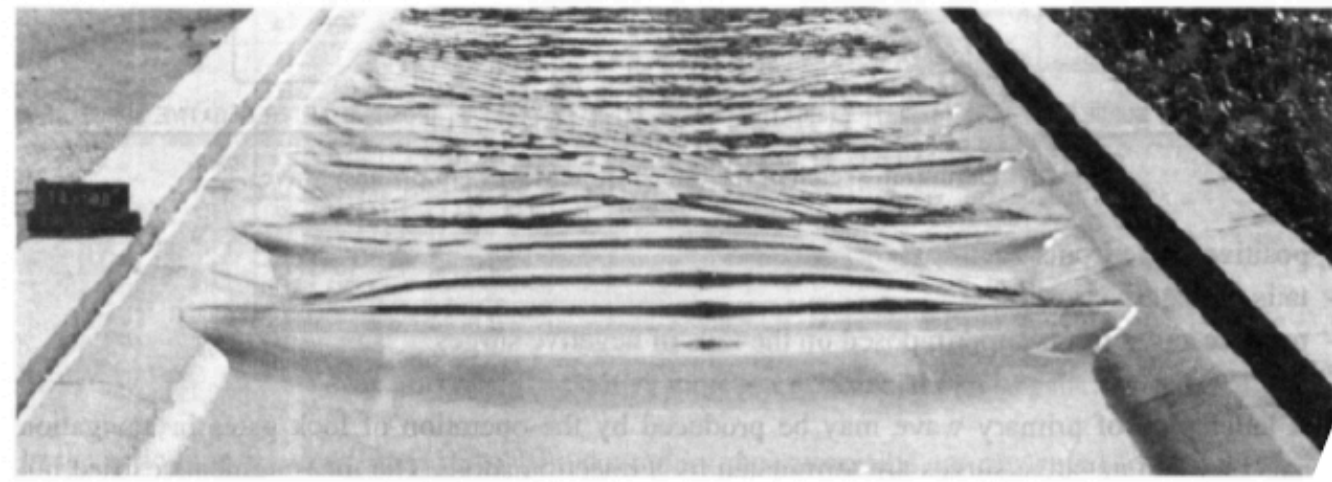
Cardamom

Lookout on possible evolutions:

some MOR for small scales and in embedded moving domains

Certified Adaptive discRete moDels for robust simulAtions of coMplex flOWs with Moving fronts

$Fr = 1.17$



Approximate/asymptotic large scale modeling

$$\vec{\psi} + \alpha \mu^2 \nabla (h^2 \nabla \cdot \vec{\psi}) = \vec{Q}(h, \vec{u})$$

$$\partial_t \zeta + \nabla \cdot (h \vec{u}) = 0$$

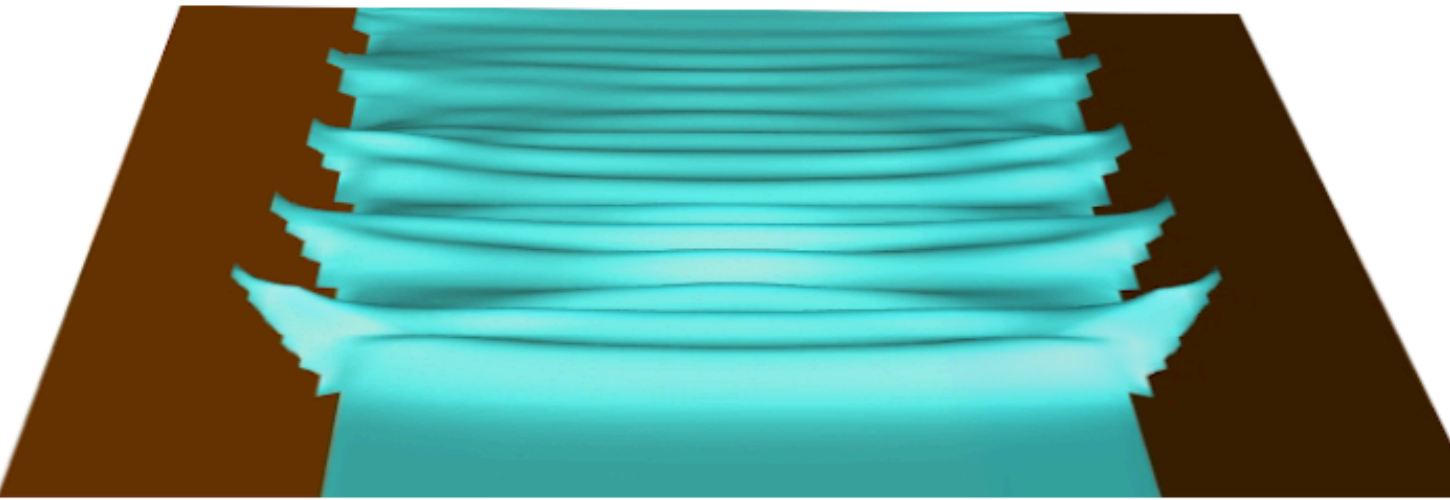
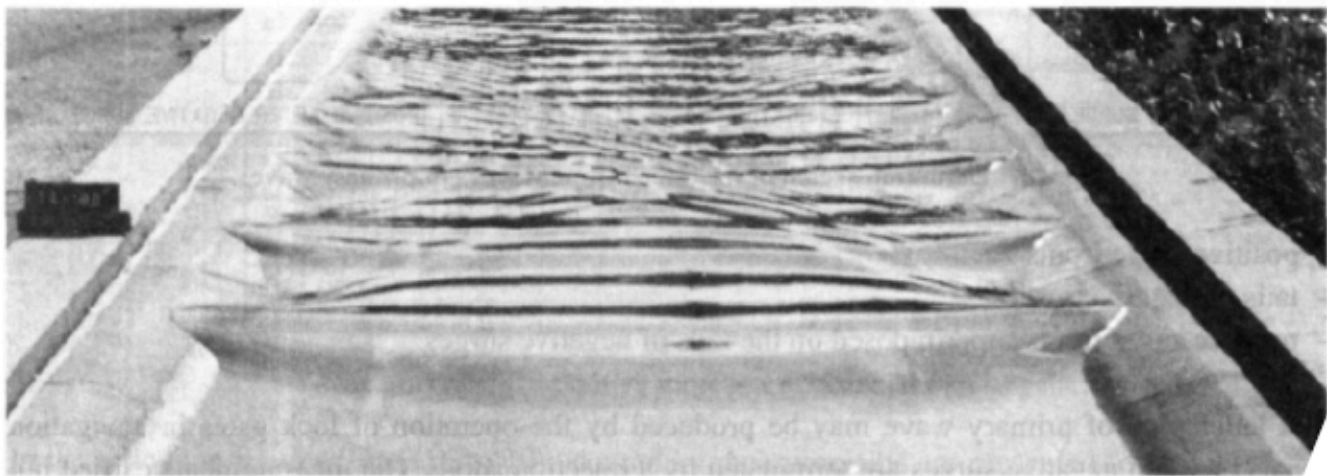
Modeling error (PDE analysis)

$$\partial_t (h \vec{u}) + \nabla \cdot (h \vec{u} \otimes \vec{u}) + c^2 \nabla \zeta = \mu^2 \vec{\psi} + \mathcal{O}(\mu^4)$$

$$\mu = \frac{\text{depth}}{\text{wavelength}}$$

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Approximate/asymptotic large scale modeling

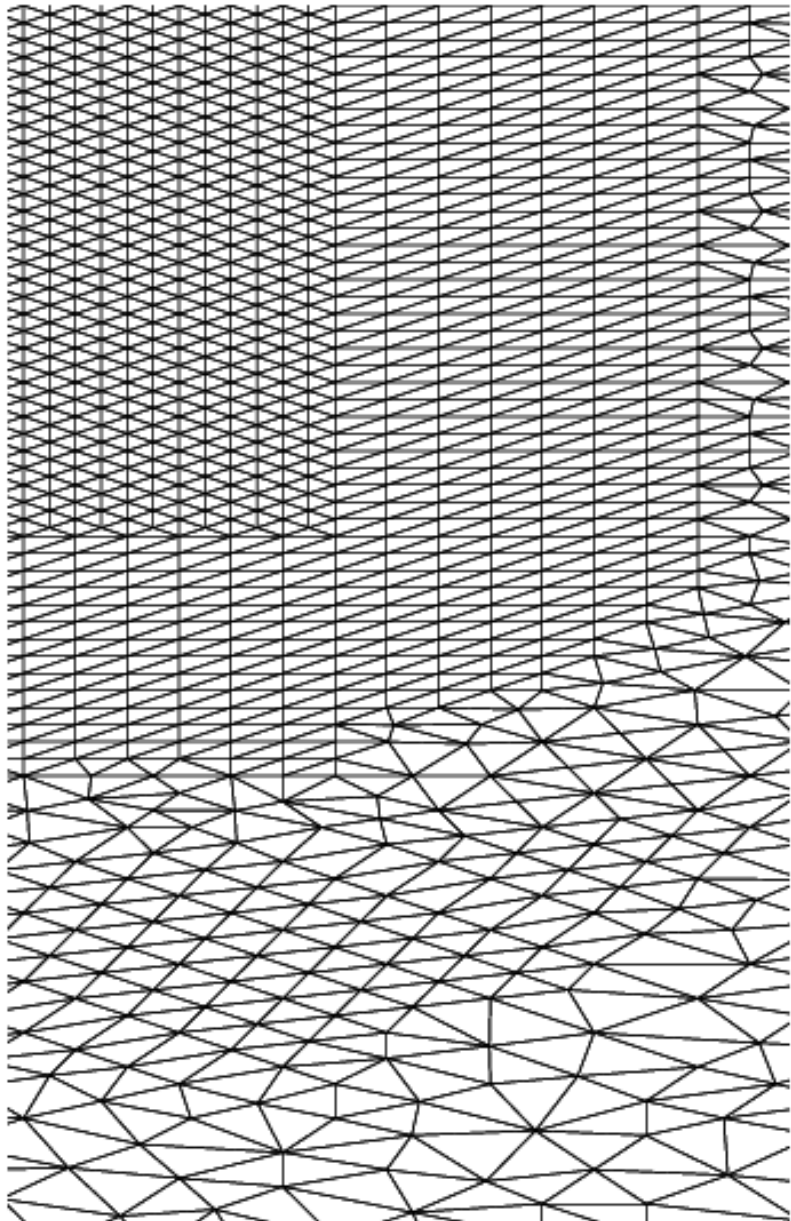
$$\vec{\psi} + \alpha \mu^2 \nabla (h^2 \nabla \cdot \vec{\psi}) = \vec{Q}(h, \vec{u})$$

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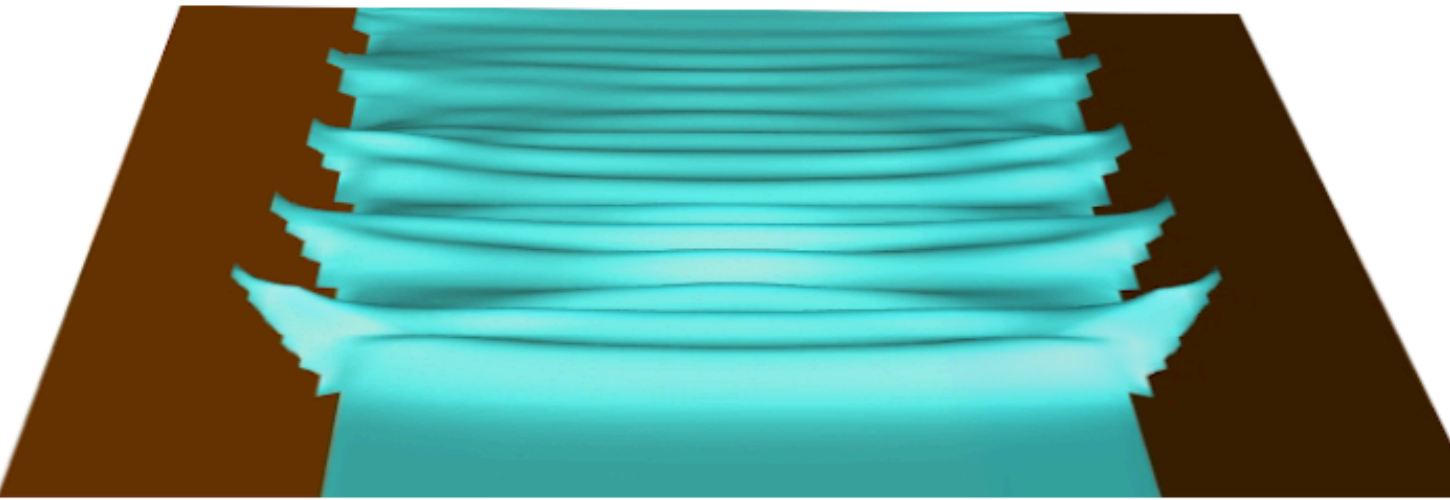
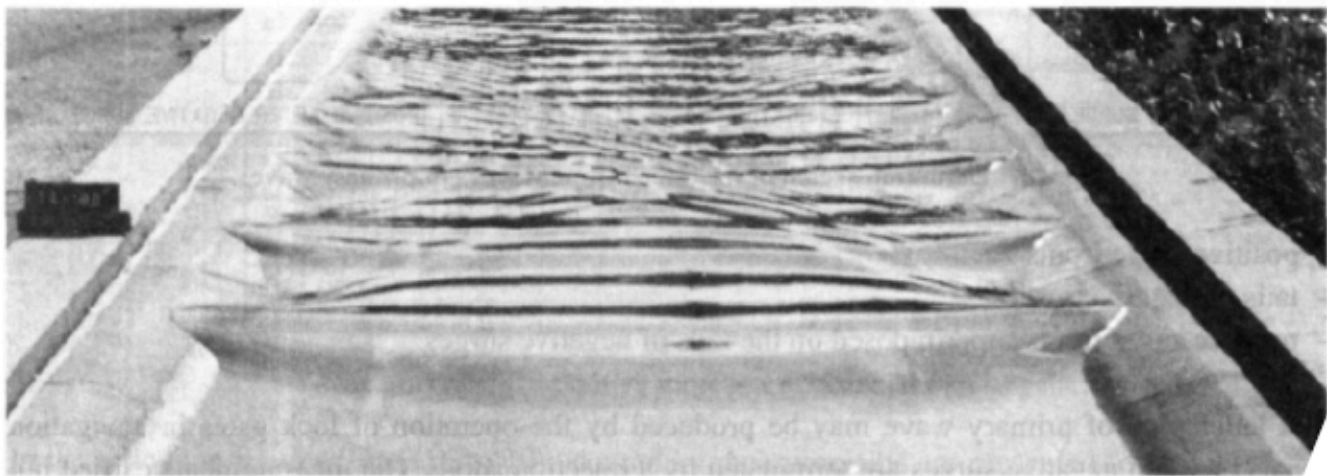
$$\partial_t (h \vec{u}) + \nabla \cdot (h \vec{u} \otimes \vec{u}) + c^2 \nabla \zeta = \mu^2 \vec{\psi} + \boxed{\mathcal{O}(\mu^4)} + \boxed{\mathcal{O}(\Delta x^p)}$$

Discretization error (Numerical analysis)



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Approximate/asymptotic large scale modeling

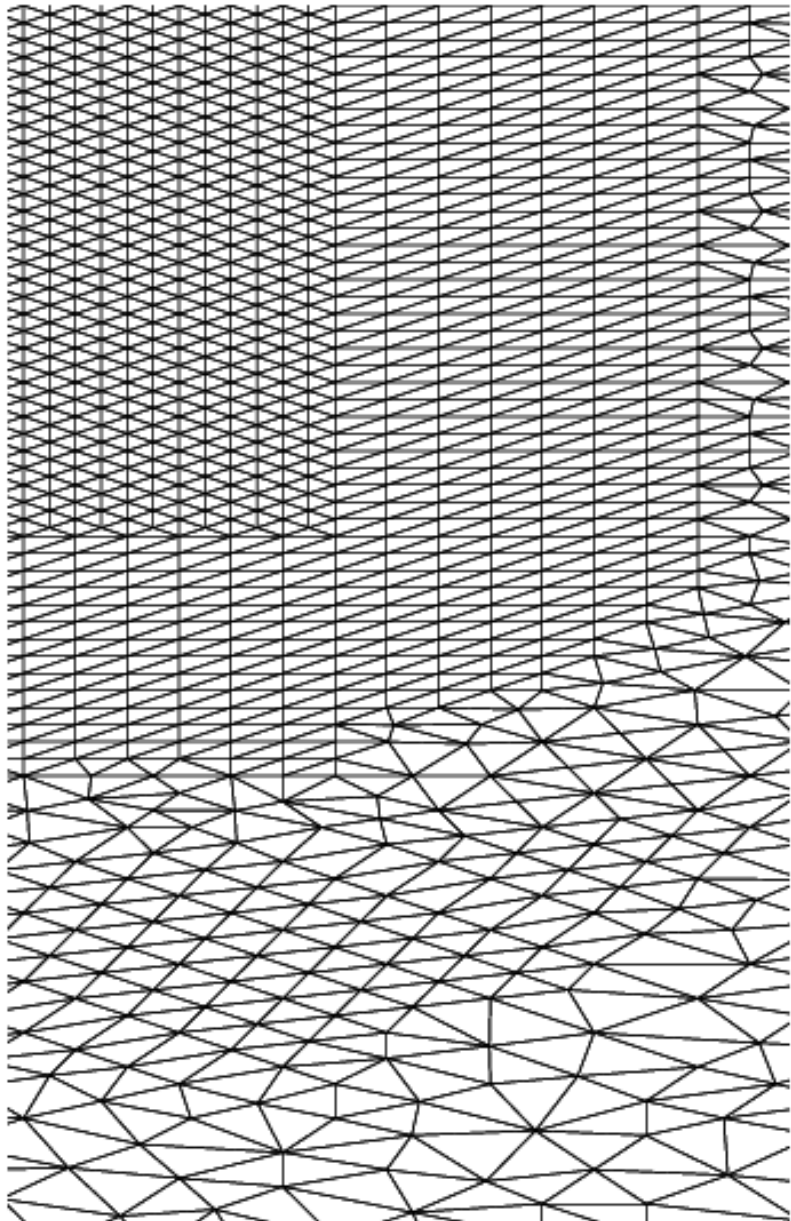
$$\vec{\psi} + \alpha \mu^2 \nabla (h^2 \nabla \cdot \vec{\psi}) = \vec{Q}(h, \vec{u})$$

$$\partial_t \zeta + \nabla \cdot (h \vec{u}) = 0$$

Modeling error (PDE analysis)

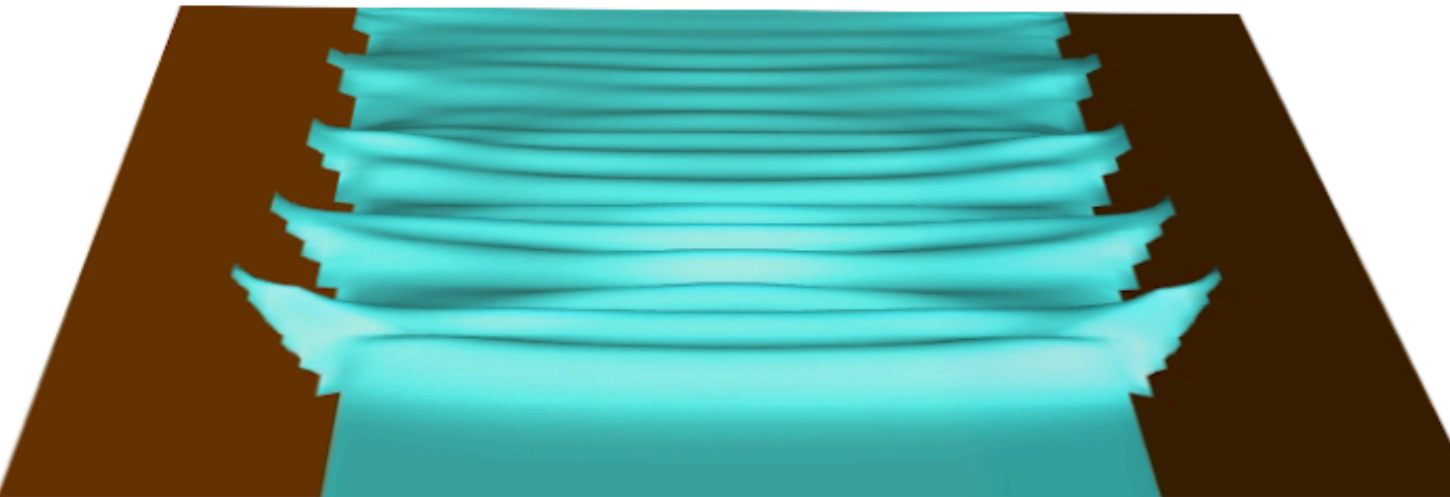
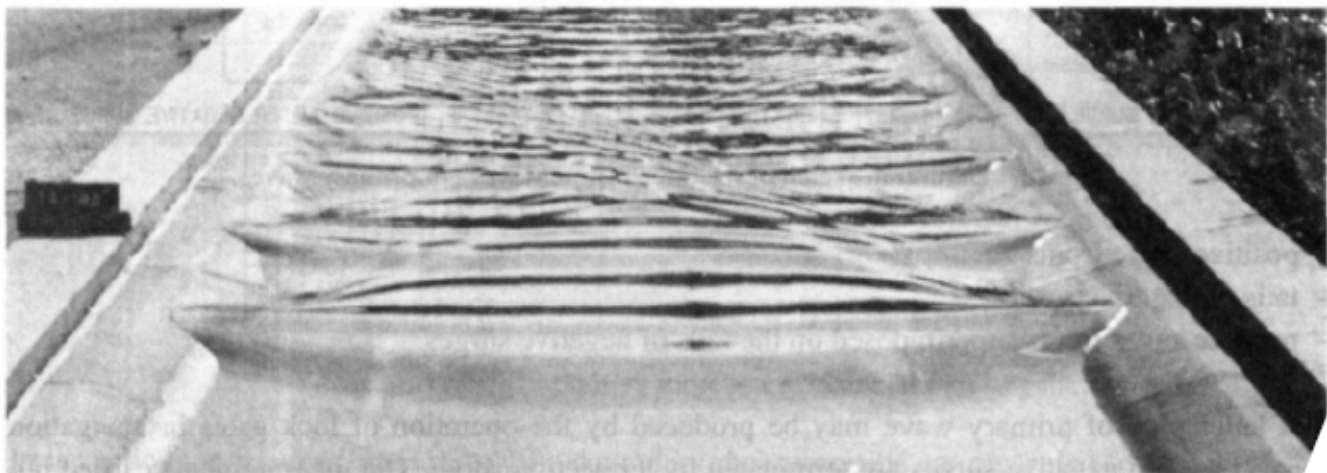
$$\partial_t (h \vec{u}) + \nabla \cdot (h \vec{u} \otimes \vec{u}) + c^2 \nabla \zeta = \mu^2 \vec{\psi} + \mathcal{O}(\mu^4) + \mathcal{O}(\Delta x^p)$$

Discretization error (Numerical analysis)

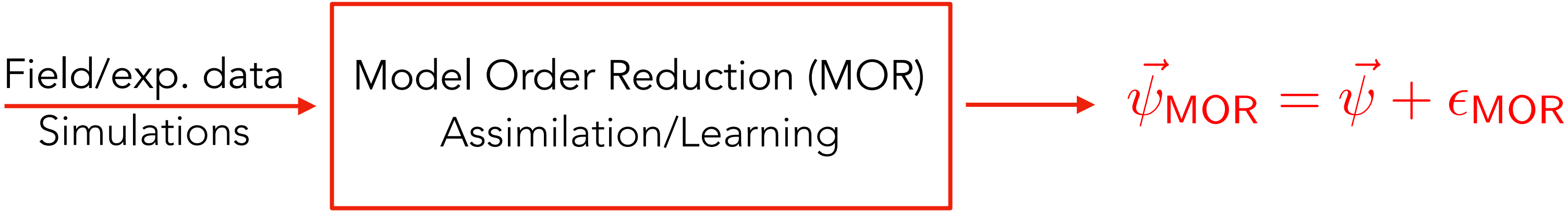


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Approximate/asymptotic large scale modeling



$$\partial_t \zeta + \nabla \cdot (h \vec{u}) = 0$$

Modeling error (PDE analysis)

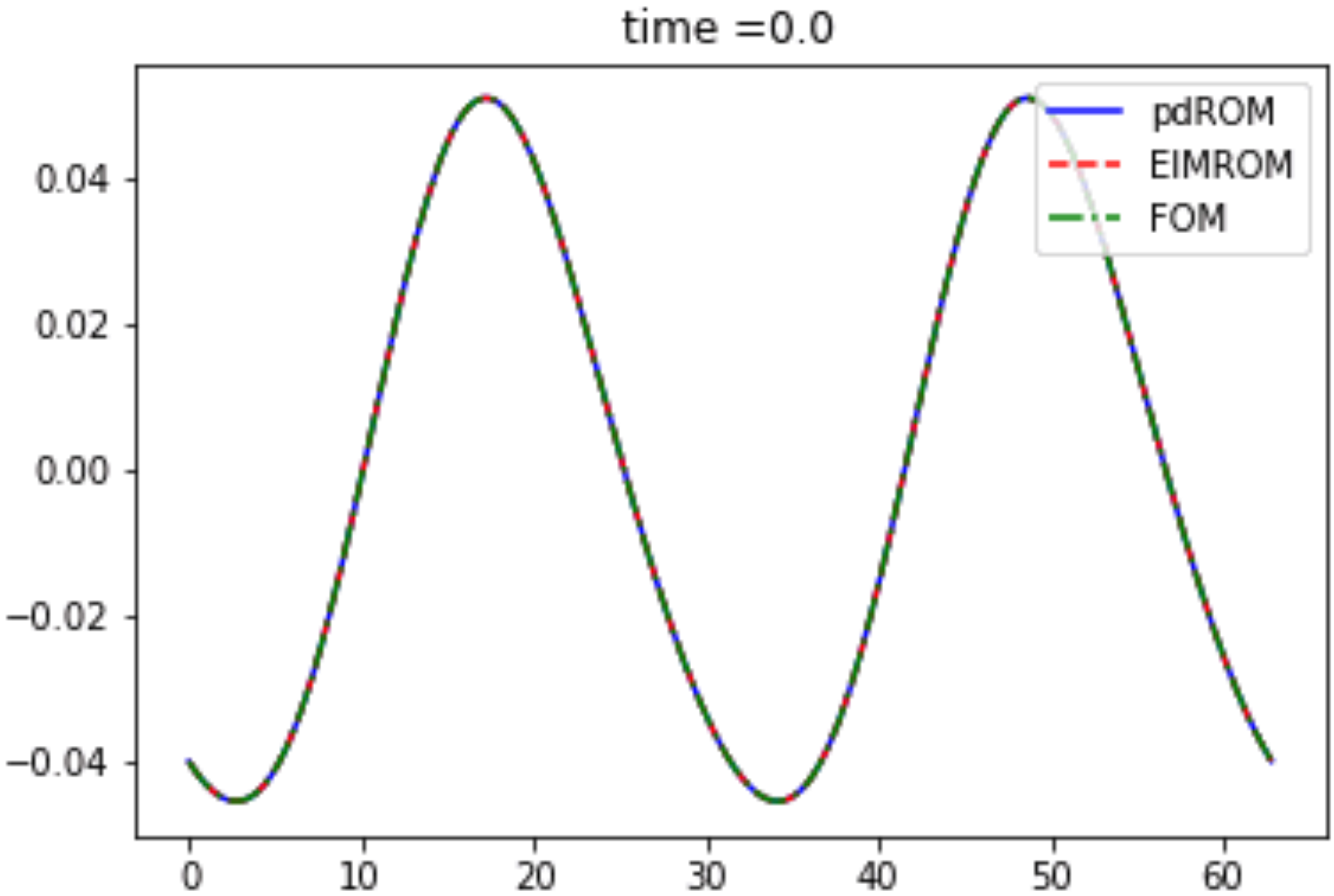
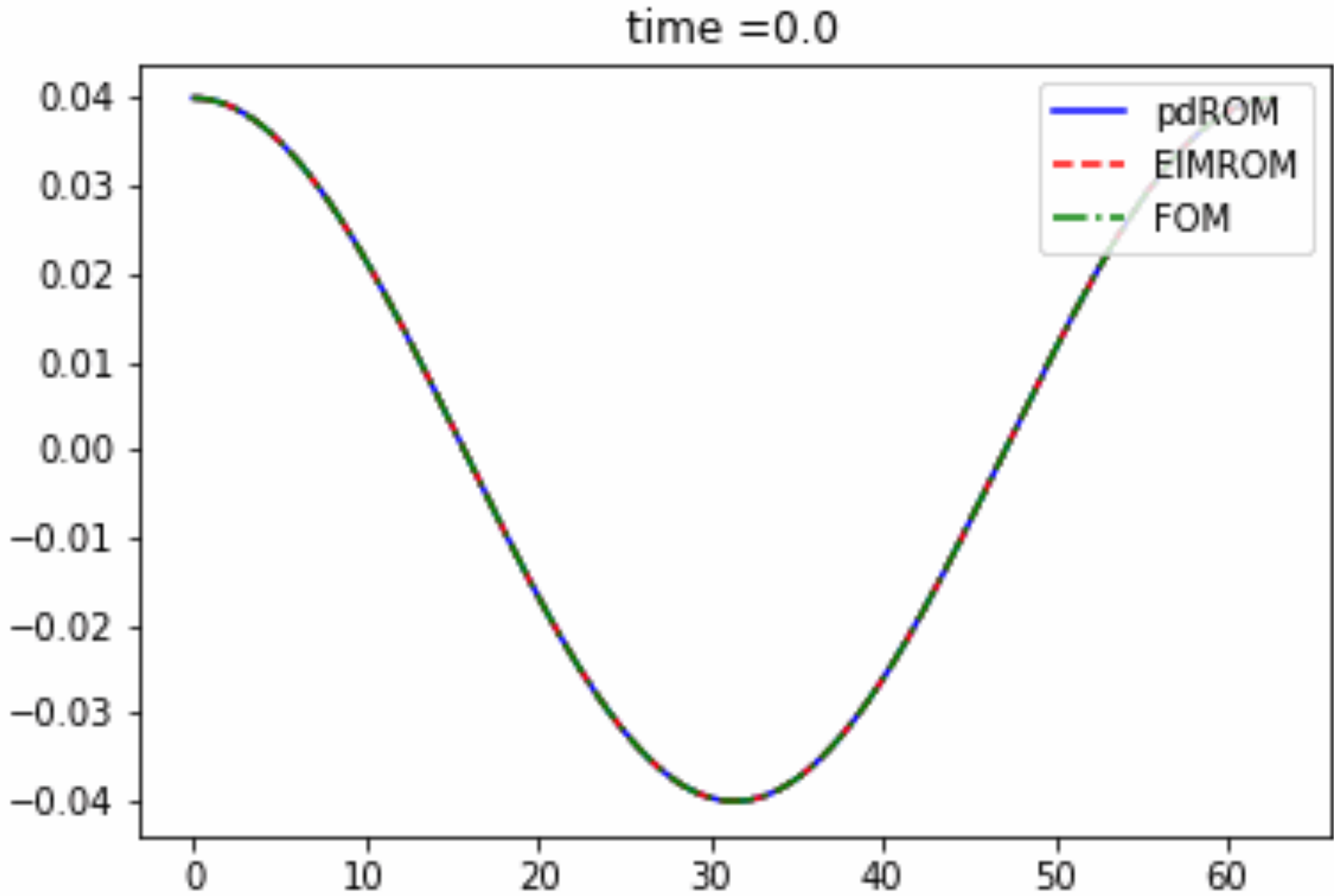
$$\partial_t (h \vec{u}) + \nabla \cdot (h \vec{u} \otimes \vec{u}) + c^2 \nabla \zeta = \mu^2 \vec{\psi} + \mathcal{O}(\mu^4) + \mathcal{O}(\Delta x^p) + \mathcal{O}(\mu^2 \epsilon_{MOR})$$

Discretization error (Numerical analysis)

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KdV/BBM model: **PDE-ROM vs ROM**

(D. Torlo/MR)



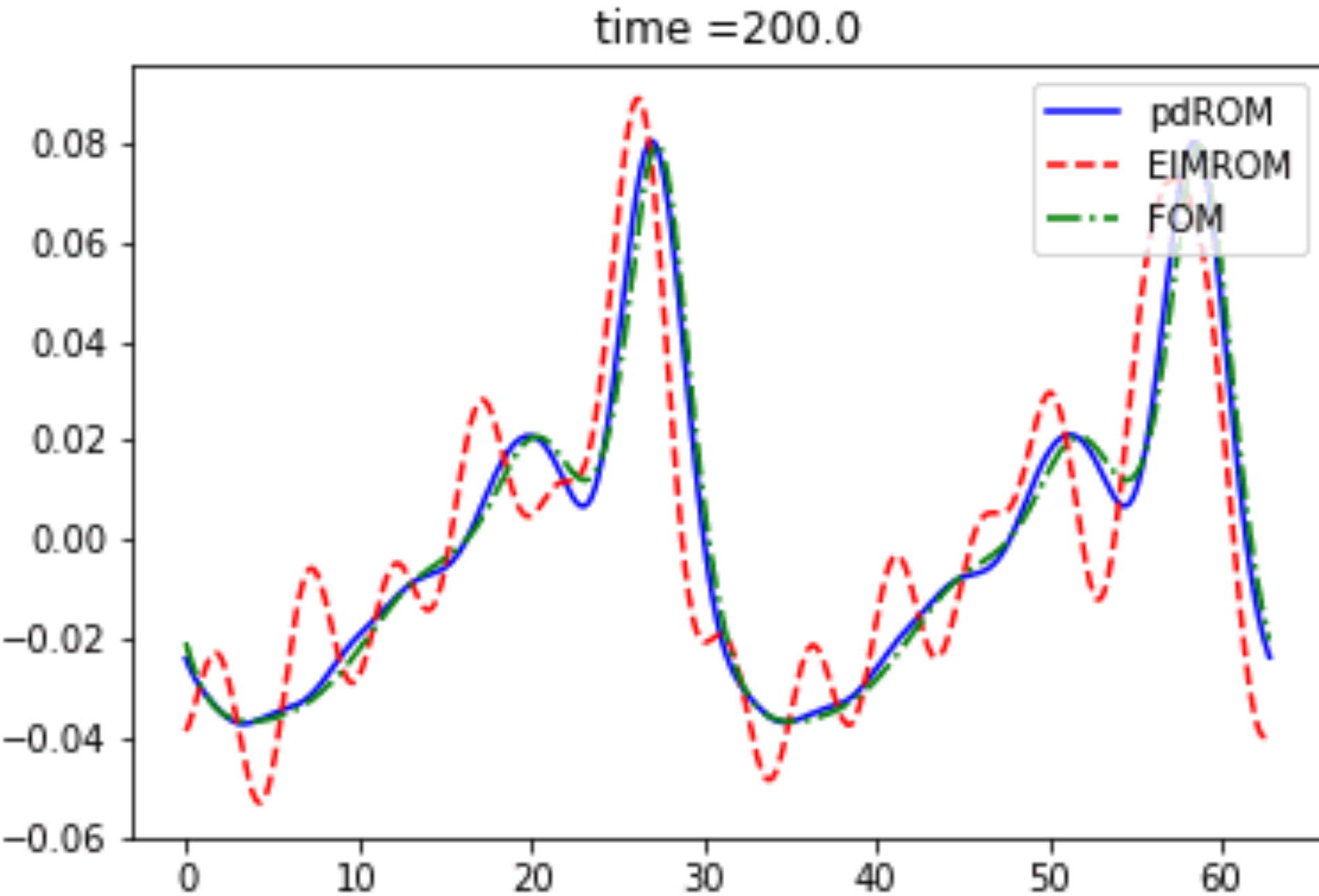
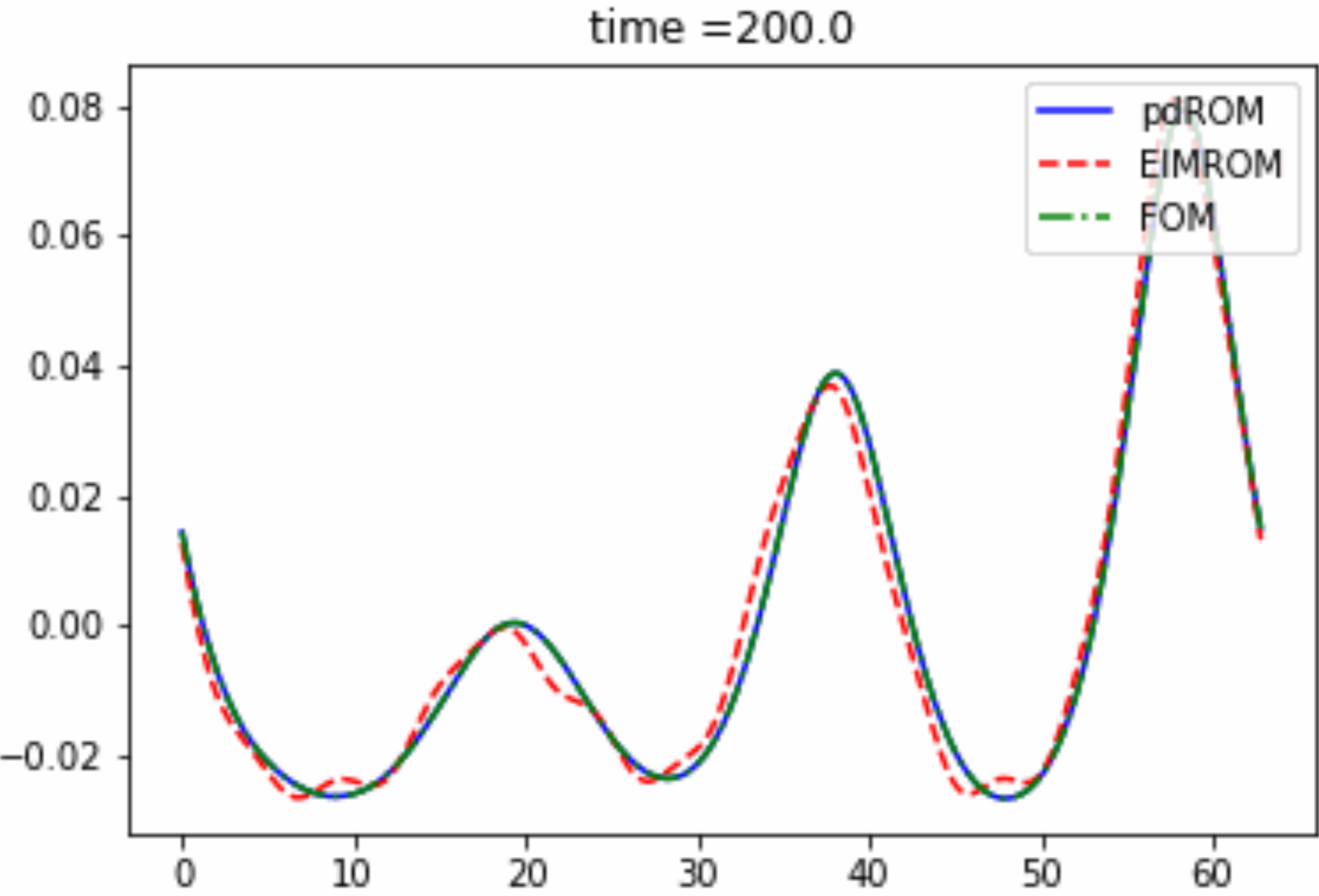
Data within the learning set

Data outside the learning set

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KdV/BBM model: **PDE-ROM vs ROM**

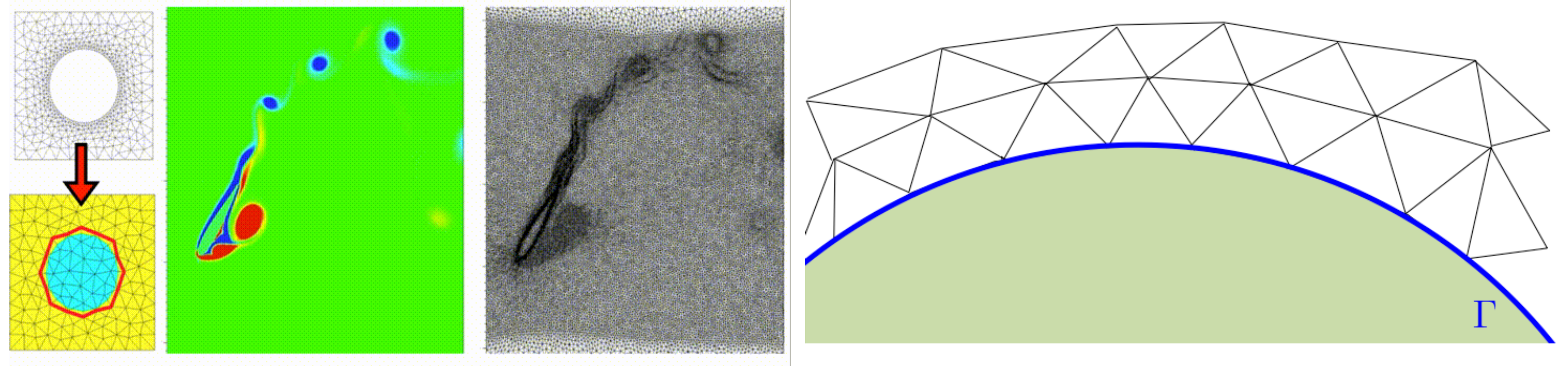
(D. Torlo/MR)



Data within the learning set

Data outside the learning set

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$$-\Delta u = f$$

$$u = g + \mathcal{O}(\mu) \text{ on } \Gamma$$

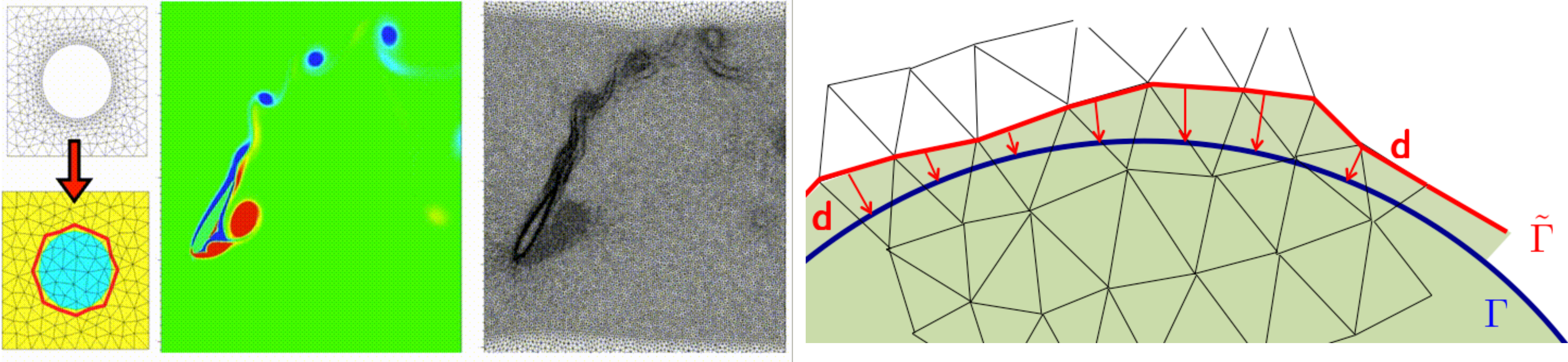
Modeling error

Turbulence and/or heat transfer

Embedded geometries, turbulence and heat transfer

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$$-\Delta u = f$$

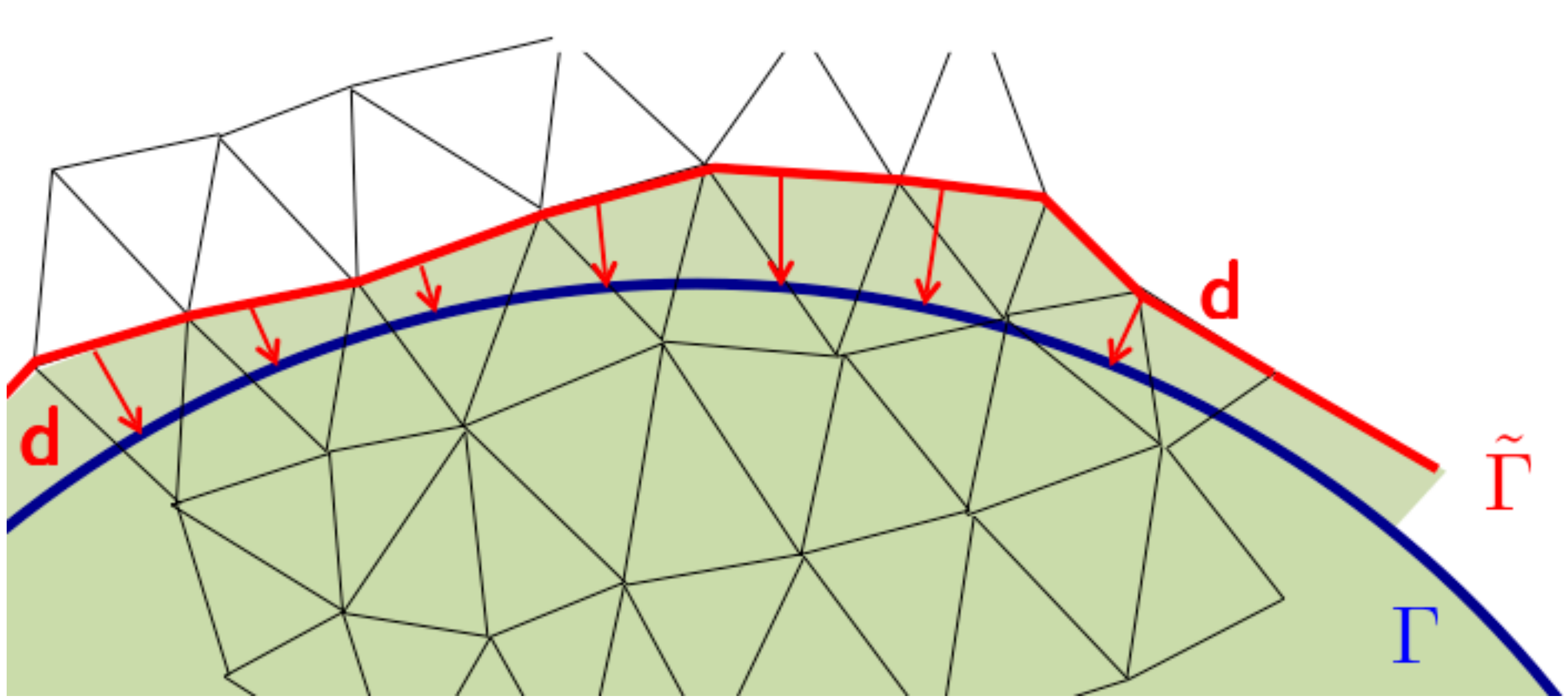
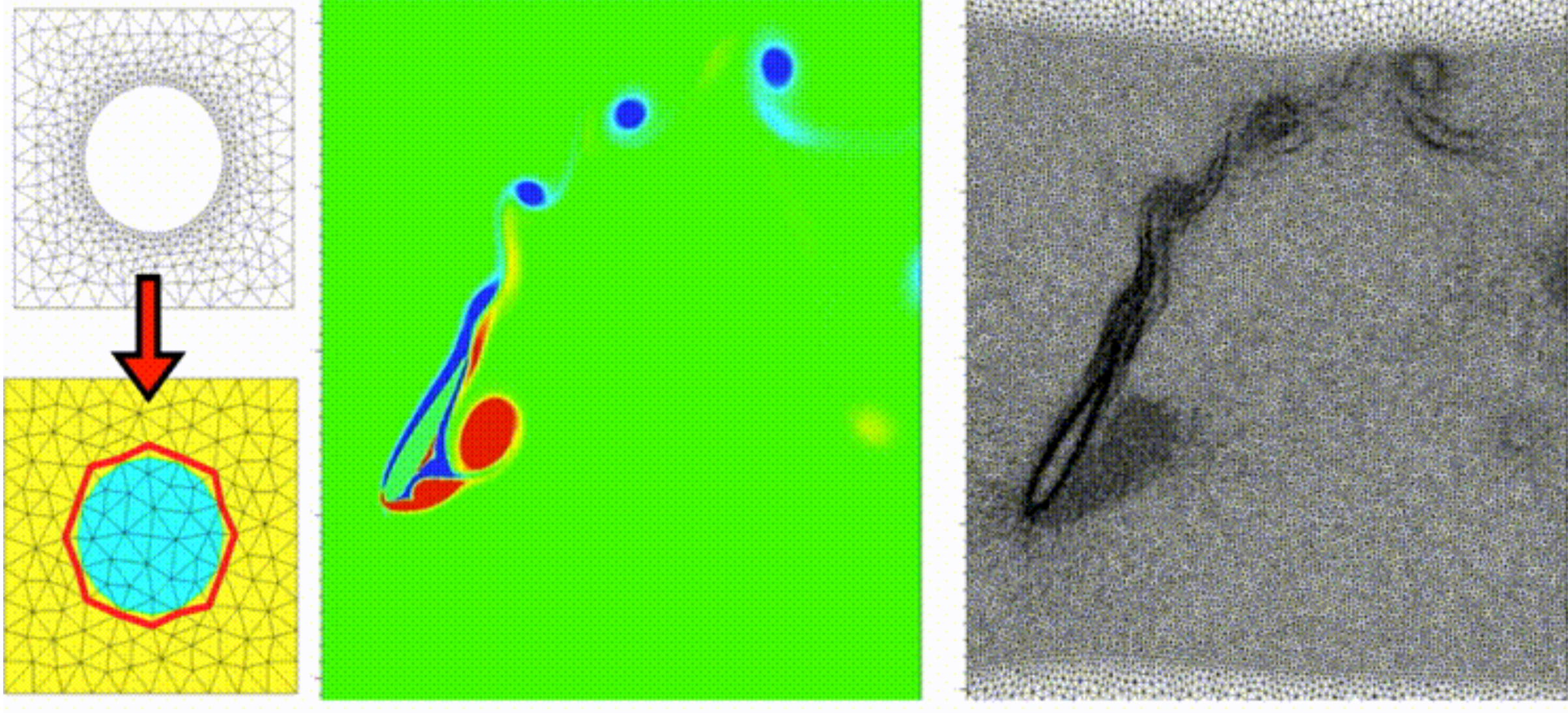
Discretization error
geometry and mesh

$$u = g + \mathcal{O}(\mu) + F_{\text{corr}}^{\tilde{\Gamma}}(d) \text{ on } \tilde{\Gamma}$$

Modeling error
Turbulence and/or heat transfer

Embedded geometries, turbulence and heat transfer

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$$-\Delta u = f$$

Discretization error
geometry and mesh

$$u = g + \mathcal{O}(\mu) + F_{\text{corr}}^{\tilde{\Gamma}}(d) + \epsilon_{\text{ML}} \text{ on } \tilde{\Gamma}$$

Modeling error
Turbulence and/or heat transfer

Model learning error
Data (experiments, HF simulations) + machine learning

Embedded geometries, turbulence and heat transfer



Lookout on possible evolutions:

some MOR for small scales and in embedded moving domains

Discussions CARDAMOM/MEMPHIS

- Projet RNA (Parisot-Bergmann-MR)
- PhD ONERA Chair (Beaugendre-Bergmann-AI)
- Discussions on PDE-MOR vs registration (Taddei, Torlo, MR)
- Discussions on possible AEx MOR-Mesh adaptation/deformation