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Liberté Égalité Fraternité

FRANCE 2030
PROGRAMME DE RECHERCHE
NUMÉRIQUE POUR L'EXASCALE

ExaMA Work Package 1 -- Feedback Session

Discretization Methods (Geometry/Physics)

WP1 Leader Name

January 21, 2026 – NumPEx General Assembly

ExaMA – Exa-scale Methodologies and Algorithms

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Key Takeaways

Key Takeaways from the GA

- Takeaway 1: *[To be completed during/after GA]*
- Takeaway 2: *[To be completed during/after GA]*
- Takeaway 3: *[To be completed during/after GA]*

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Discussions Summary

Main Discussion Points

- Discussion 1: Collaborations within WP1. So far, the collaborations between different institutions are considered insufficient. To improve this and guarantee stronger collaborations, one suggestion is to organize systematic co-advisory - between Exama contributors - of the new PhD students or postdoctoral fellows to be recruited.
- Discussion 2: Scientific animation. To foster stronger interactions within WP1, we wish to organize more joint seminars or scientific events. The hope is that this stimulates discussions that may convert into concrete collaborations. For those who cannot attend, we can share the slides online with minimal overhead. The same principle holds for sharing some slides presented at conferences, or the slides presented by interns. This may suggest organizing internships co-advised between partners.

Main Discussion Points

- Discussion 3: Dissemination. We wish to propose the organization of minisymposia at conferences such as (National) CANUM-SMAI, CFM, or (International) Coupled, ECOMASS, Meshing roundtable, Symposium on Geometry Processing.
- Discussion 4: Physics-informed mesh generation. Optimize the condition number of a discrete differential operator derived from physics.
- Discussion 5: domain partitioning for meshing vs simulation. How to conciliate both?
- Discussion 6: Modeling cities for radiative and conductive thermal simulation. Simulation via Modelica and Dinoca. Meshes are used to calculate solar masks.

Software and WP1-2

- Objectives: stimulate collaborations to help develop the software tools: refine problem statement / specifications, benchmark on specific use cases.
- Library Ktirio-geom: 3D reconstruction and meshing of entire cities and perform thermal simulation (radiative and conductive), with unstructured surface triangle meshes. The terrain, buildings and trees are meshes in parallel, then merged into a unique large-scale mesh. Tools for mesh generation are taken from GMesh and CGAL.
- Feel++ (C++ library for continuous or discontinuous Galerkin methods).
- Multiphysics and coupling:
- AMR (adaptive mesh refinement): the current workflows are not very streamline. Some events are sent by the simulation part to the mesh generation part. Safran: crack propagation via conforming remeshing. Before: some tools from Distene were used, but there are licence issues.
- CEA: bottleneck with massive meshes that are way too slow to load in main memory.

Software and WP1-2

- High-order: some teams interested?
- Inria: we worked on optimization of unstructured curved tetrahedral meshes (Bézier of arbitrary order). In case this is of interest, we would be glad to share our prototype and collaborate.
- Reduced models: it would be interesting to compare the scalability of different methods/solvers. Currently two approaches: either a scalable solver with the full system (monolithic design), or distributed physics with many systems solved and synchronization.
- Needs for PINNS or reduced models: solvers to generate a wide range of solutions on diverse meshes, used as training data. The solvers must be pliant and general in order to handle a wide range of meshes and simulations. Questions: can we train on low-resolution and then fine-tune?
- Need: Maxwell high frequency [to precise].
- Trainable solver vs call to solvers ?
- Alternative is symbolic training, i.e. directly learn analytical functions.
- In the new WG5 of PC5, a working group will explore coupled AI simulation.

Feedback from Other WPs

WP2 *[Feedback received]*

WP3 *[Feedback received]*

WP4 *[Feedback received]*

WP5 *[Feedback received]*

WP6 *[Feedback received]*

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Action Items

Action Items Identified

Action	Owner	Deadline
Action 1	Name	MM/YYYY
Action 2	Name	MM/YYYY
Action 3	Name	MM/YYYY

New Collaborations

- Collaboration opportunity 1: *[Description]*
- Collaboration opportunity 2: *[Description]*

Adjustments

Adjustments to WP1 Plans

- Adjustment 1: *[Description]*
- Adjustment 2: *[Description]*
- Adjustment 3: *[Description]*

Updated Priorities

1. Priority 1: *[Updated priority]*
2. Priority 2: *[Updated priority]*
3. Priority 3: *[Updated priority]*

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Conclusion

Summary and Next Steps

- Main outcomes from the GA
- Immediate next steps
- Follow-up meetings planned

Thank you!