EXASCALE

ExaMA

Methods and Algorithms at ExaScale

Christophe Prud'homme & Hélène Barucq

October 11, 2022

Overview

1. Introduction

2. Presentation of ExaMA

3. Relations

Introduction

Introduction

Tour de Table

- CEA
  - DAM **Lydie Grospellier** (LG)
  - DES **Vincent Faucher** (VF) **Isabelle Ramière** (IR)
- INRIA B
  - Bordeaux **Hélène Barucq** (HB) **Luc Giraud** (LG)
  - Grenoble **Arthur Vidard** (AV)
  - Lille **El-Ghazali Talbi** (ET)
  - Paris **Laura Grigori** (LG)
  - Sofia **Stephane Lanteri**(INRIA-Sofia) (SL)
- IPP **Josselin Garnier Marc Massot** (MM) **Loic Gouarin** (LG)
- UNISTRA **Christophe Prud'homme**(UNISTRA) (CP)

Introduction

ExaMA

NUMPEX/ExaMa concentrates on the exascale aspects of the numerical methods, ensuring their scalability to existing and forthcoming hardware.

Leaders: C Prud'homme & H Barucq

- 5 Work packages
- wide range of topics:
  - Modeling and discretize
  - Linear, multi-linear and coupled solvers at Exascale
  - Combine data and models at Exascale
  - Optimize and quantify uncertainties at Exascale
- Demonstrators through mini-apps will be used to verify the properties of the methods and algorithms developed.

Introduction

initial Working Group

- 10 persons in initial work groups
- Other teams consulted on various topics
- Initial Budget: 7 Mio Euros, now a bit more than 6Mio Euros

Presentation of ExaMA

Presentation of ExaMA

Identified Bottlenecks/Challenges

- (C1) Reduce carbon (GHG) footprint in transportation, buildings, and cities
- (C2) Design, control, and manufacture of advanced materials
- (C3) Understand and simulate the human brain
- (C4) Understand fission and fusion reactions and design advanced experiment facilities for fusion
- (C5) Monitor the health of our planet: climate prediction, impact assessment of environmental policies, rapid environmental hazards
- (C6) Monitor and personalize the health of human beings
- (C7) Design drugs
- (C8) Design cost-effective renewable energy resources: batteries, biofuels, solar photovoltaics
- (C9) Understand the Universe

Presentation of ExaMA

Identified Bottlenecks/Challenges

- (B1) Energy efficiency
- (B2) Interconnect Technology
- (B3) Memory technology
- (B4) Scalable systems software
- (B5) Programming systems
- (B6) Data Management
- (B7) Exascale Algorithms
- (B8) Discovery, design, and decision algorithms
- (B9) Resilience, robustness and accuracy
- (B10) Scientific productivity
- (B11) Reproducibility, replicability of computation
- (B12) Pre/Post-processing
- (B13) Integrate Uncertainties

Presentation of ExaMA

Status

- Currently building WP team
- try to get people from CEA,INRIA,CNRS and University
- try to have both men and women in the steering team
- 2/3 co-lead per WP in charge of specific topics
- Some WPs will be probably further split

WP1	S Lanteri, V Faucher C Prud'homme H Barucq
WP2	L Grigori, L Giraud ...
WP3	E Blayo, M Nodet, M Asch
WP4	C Prieur, Cambodo? V Monbet, Y Privat, M Darbas, H Barucq
WP5	CEA/DAM? C Prud'homme

Table 1: WP team

Presentation of ExaMA

Core Sites

Table 2: Core sites (to be discussed)

CEA	University/CNRS	INRIA
CEA-DAM	Sorbonne Universités	Inria Paris
CEA-DES	Université de Strasbourg	Inria Bordeaux
CEA-DRF	Université de Pau/Toulouse	Inria Sofia
	Université Grenoble Alpes	Inria Lyon
	Université Paris Saclay	Inria Lille

Presentation of ExaMA

Core Sites

Some issues/questions:

- potentially a lot of teams interested, find the right level
- any policies about leaders involvement and their team?

Presentation of ExaMA

Expected results

- Methods, algorithms, and implementations that, taking advantage of the exascale architectures, empower modeling, solving, assimilating model and data, optimizing and quantifying uncertainty, at levels that are unreachable at present.
- Software libraries allowing to assemble specific critical reusable components, hiding the hardware complexity and exposing only the specific methodological interface
- Methodological and Algorithmic Patterns at exascale that can be reused efficiently in large scale applications (eg in weather forecasting)
- Enabling AI algorithms to attain performances at exascale, exploiting the methods (point 1) and the libraries (point 2) developed.
- ▸ Demonstrators

Presentation of ExaMA

Milestones

- M1 Select IP-1 use-cases/demonstrators and associate methodology developments T0+6
- M2 benchmark IP-1 demonstrators on pre-exascale systems T0+9/T0+12
- M3 enable and benchmarks some new exascale IP-1 components on pre-exascale/exascale systems T0+18, T0+36, T0+54, T0+60

Presentation of ExaMA

Budget

- large project involved many teams
- need enough momemtum
- initially 7Mio Euro
- proposed budget 6Mio Euro
-

Relations

Relations

Industry

Contacted Entreprises

- EdF
- Safran

To be contacted

- Arkema
- Total
- PlasticOmnium
- Atos
- Entreprises from Consortium Mordicus
- ...

Relations

PEPR

- IA
- Diadem ?
- TRACCS-Météo?

Links were made with CMA IA MAIAGE (training), results end of September.

Relations

Europe

- Coe Hidalgo-2
- ERC-Synergy EMC2
- EuroHPC Microcard
- H2020 RIA Digital Twin Bim2Twin
- CoE EoCoE-3
- EuroHPC European Master for HPC - EUMaster4HPC

Relations

Training

- Communication with Masters and Doctoral Schools about Numpex/ExaMa
- Do it as early as possible to ensure that eg Master track to include HPC courses inline with ExaMA
- EuroHPC European Master for HPC - EUMaster4HPC
- Other aspects: Develop training material for ExaMA

Relations

Interactions with Genci and Tier-0

- TBD