

Two **open calls** in Numerical Analysis and Scientific Computing

# Development of novel numerical methods for the solution of hyperbolic equations on unstructured meshes

Supervisor: Prof. **Elena Gaburro** ([elena.gaburro@univr.it](mailto:elena.gaburro@univr.it))  
Department of Computer Science, University of Verona, Italy

## Keywords

High order numerical methods, discontinuous Galerkin (DG) schemes, hyperbolic equations, Arbitrary-Lagrangian-Eulerian (ALE) schemes, unstructured meshes, structure preserving techniques

## ✓ OPEN CALL for a POSTDOCTORAL POSITION

- Link to the official call:  
<https://www.univr.it/it/concorsi/assegnisti-di-ricerca/assegni-di-ricerca/0/12874>  
The second part of the published PDF is in English.
- **Salary: 2,000 EUR net per month.**
- **Duration: 1 year** with the possibility of being **renewed every year, for a total of 4 years.** With each renewal a **salary increase** is also negotiable.
- **Application deadline: 17 of April 2024** (shiftable by a few weeks at the explicit request of interested candidates, please contact [elena.gaburro@univr.it](mailto:elena.gaburro@univr.it) as soon as possible).
- Application modality: CV and a 2-pages Research Statement (the interested candidate can take contact with [elena.gaburro@univr.it](mailto:elena.gaburro@univr.it) to eventually discuss the preparation of the research statement).
- Expected starting date: from summer 2024.
- Further details on the research program: see next page.

## ✓ OPEN CALL for expression of interest for a PHD POSITION

- (ENGLISH VERSION) Expected net monthly **salary**: between 1200 and 1500 euros (depending on the chosen call format, to be agreed with the candidate)
- **Deadline**: interested candidates are kindly invited to contact [elena.gaburro@univr.it](mailto:elena.gaburro@univr.it) **as soon as possible** (ideally beginning of April 2024). The call will be open in May 2024. The contract will start in November 2024. (Paid internships can be organized between August and October).
- Research subject: see next page.
- (VERSIONE in ITALIANO) **Retribuzione** mensile netta: tra i 1200 e 1500 euro (questo dipende dal tipo di concorso che verrà aperto e per questo è necessario conoscere i candidati interessati con largo anticipo).
- **Scadenza**: i candidati interessati sono pregati di contattare [elena.gaburro@univr.it](mailto:elena.gaburro@univr.it) **il prima possibile** (idealmente inizio Aprile 2024). Il concorso sarà aperto in Maggio. L'inizio del contratto è previsto per Novembre 2024. (Eventuali stage retribuiti possono essere organizzati da Agosto a Ottobre).
- Soggetto di ricerca: vedere pagina seguente.

## Research program for the two calls

The research activity funded by this grant will be carried out in the context of the ERC Starting Grant ALcHyMiA: "Advanced Structure Preserving Lagrangian schemes for novel first order Hyperbolic Models: toward General Relativistic Astrophysics" (GA 101114995). The assignee will work on the **development and validation of new numerical methods**, of Finite Volume and Discontinuous Galerkin type, for solving systems of nonlinear **hyperbolic equations**. The methods will be developed on polygonal (or polyhedral) meshes possibly moving (in the context of Arbitrary-Lagrangian Eulerian techniques). They will also be characterized by **structure preserving properties** at the geometric level (preservation of interfaces, Galilean and rotational invariance) and/or at the physical level (preservation of equilibria, involution constraints, nonlinear stability). The obtained methods will be applied in the field of **computational fluid dynamics** (e.g. Euler equations, multiphase models ...) and/or **computational astrophysics** (Euler-Einstein equations).

### Main activities:

- Literature review
- Participation in advanced courses in Italy and abroad
- Research activity on high order numerical schemes
- Research activity on mesh generation/adaptation
- Code development and validation in Fortran
- Redaction of scientific and outreach papers
- Presentation of new results in national and international events

### Complementary activities:

- Teaching
- Proposal writing (for personal travel and research grants)

### Prerequisites for PhD position/Postdoctoral position

- Master degree/PhD degree in mathematics, physics, engineering or informatics
- Basic/Good programming skills
- Interest for learning, developing and applying new knowledge
- Previous experience with numerical methods of Finite Elements or Finite Volume type for the solution of partial differential equations will be positively evaluated
- Good level of written and spoken English

### Additional skills:

- Able to work autonomously
- Good level of self-organization

### Contact person: Elena Gaburro

Mail: [elena.gaburro@univr.it](mailto:elena.gaburro@univr.it)

Web page: <https://www.elenagaburro.it/>

**Note: For any information feel free to contact me!**

### Bibliography

See our recent published papers: <https://www.elenagaburro.it/publications.html>