



# PhD in INGEGNERIA STRUTTURALE, SISMICA, GEOTECNICA / STRUCTURAL SEISMIC AND GEOTECHNICAL ENGINEERING - 39th cycle

**THEMATIC Research Field: DEVELOPMENT OF AN URGENT HIGH-PERFORMANCE  
COMPUTING FRAMEWORK FOR THE RAPID PHYSICS-BASED SIMULATION OF  
EARTHQUAKE IMPACT AT REGIONAL SCALE**

**Monthly net income of PhDscholarship (max 36 months)**

**€ 1195.5**

In case of a change of the welfare rates during the three-year period, the amount could be modified.

## Context of the research activity

### Motivation and objectives of the research in this field

Large, destructive earthquakes can severely impact local population causing considerable human, social and economic losses, as dramatically pointed out by the recent M7.8 February 6, 2023 earthquake in Turkey. Mitigation of seismic risk can be pursued by preemptive planning, but also by rapid deployment of emergency rescue teams in the aftermath of the event. Referring to the emergency response, the rapid assessment of damages and their spatial distribution is essential. This can be obtained by collecting direct observations (e.g., measurements, reports) or indirectly by numerical modelling of the earthquake impact, or a mixture thereof. However, while the former could be affected by the latency of the data collection, the latter is preferable in the event aftermath, as damage scenarios can be nowadays simulated effectively in a reasonable amount of time using analytical/numerical approaches.

Scope of this doctorate is the development of a methodological workflow for the generation of (quasi) real-time earthquake impact scenarios at regional scale, with implication for emergency response of civil protection authorities. The earthquake-induced impact scenarios will be produced by combining the ground motion simulation obtained through a 3D physics-based numerical simulation approach with existing fragility and vulnerability



	<p>models for the exposed assets in the target region. The approach will be verified and validated on suitable testbeds, using damage observations obtained during real earthquakes.</p> <p>The methodological workflow will be implemented and tested on large High-Performance Computing (HPC) infrastructure facilities, by endorsing Urgent Computing (UC) priority policies. As a matter of fact, to achieve the objective of the project, impact scenarios must be generated very rapidly and HPC resources might not always be readily available during an emergency. For this reason, the development of an UC framework on dedicated infrastructures is essential.</p>
<b>Methods and techniques that will be developed and used to carry out the research</b>	<p>Numerical ground motion simulation will be performed using the spectral element software SPEED (<a href="http://speed.mox.polimi.it/">http://speed.mox.polimi.it/</a>) on the High Performance Computing facility of the CINECA consortium. The modeling will benefit from seismological data and knowledge collected by the seismological monitoring network of the Italian National Institute of Oceanography and Applied Geophysics - OGS.</p>
<b>Educational objectives</b>	<ul style="list-style-type: none"> <li>- Understanding physics-based numerical approaches for ground motion prediction;</li> <li>- Mastering tools for HPC computing;</li> <li>- Modeling of regional-scale 3D seismic wave propagation problems;</li> <li>- Development of seismic risk models;</li> <li>- Development, application and testing of seismic damage scenarios for emergency planning.</li> </ul>
<b>Job opportunities</b>	<p>The candidate is expected to develop interdisciplinary skills, in the areas of engineering seismology and seismic risk analysis. This will allow him/her to have employment opportunities in academia and in public and private companies in the field of disaster risk reduction with specific focus on earthquakes-induced risks.</p>
<b>Composition of the research group</b>	<p>1 Full Professors 1 Associated Professors 0 Assistant Professors 0 PhD Students</p>



<b>Name of the research directors</b>	C. Smerzini, R. Paolucci, C. Scaini, V. Poggi
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<b>Contacts</b>
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<b>Additional support - Financial aid per PhD student per year (gross amount)</b>	
<b>Housing - Foreign Students</b>	--
<b>Housing - Out-of-town residents (more than 80Km out of Milano)</b>	--

<b>Scholarship Increase for a period abroad</b>	
<b>Amount monthly</b>	597.75 €
<b>By number of months</b>	6

**Additional information: educational activity, teaching assistantship, computer availability, desk availability, any other information**

**Educational activities**

The Ph.D. course supports the educational activities of its Ph.D. students with an additional funding equal to 10% of the scholarship, starting from the first year.

**Teaching assistantship**

Ph.D. students are encouraged to apply, upon prior authorization, to the calls to support teaching activities at the undergraduate and Master levels at Politecnico, being paid for that. The teaching assistantship will be limited up to about 80 hours, maximum half of them devoted to teaching and classroom activities and the rest to support classworks and exams.

**Computer availability**

Each Ph.D. student has his/her own computer for individual use.

**Desk availability**

Each Ph.D. student has his/her own desk, cabinet and locker.