


IMT Mines Alès
École Mines-Télécom


SCIENCE & CREATIVITY TO INVENT A SUSTAINABLE WORLD

PhD Position in

water pollution crisis management

Institution	IMT Mines Alès (Ecole Nationale Supérieure des Mines d'Alès)
Main job assignment	Centre de Recherche et d'Enseignement en Environnement et en Risques
Administrative residence	Alès (Département du Gard – Région Occitanie)
Starting date	September 2025

1. Context

The Institut Mines-Télécom (IMT), a major institution within the meaning of the Education Code, is a public scientific, cultural and professional institution (EPSCP) placed under the principal supervision of the ministers responsible for industry and digital technology. It is the largest group of engineering schools in France, with 11 public engineering schools spread across the country, which train 13,500 engineers and PhDs each year. The ITM employs 4,500 people and has an annual budget of €400M, 40% of which comes from its own resources. IMT has 2 Carnot institutes, 35 industrial chairs, produces 2100 A rank publications annually, 60 patents and carries out 110M€ of contractual research.

Created in 1843, IMT Mines Alès currently has 1,400 students (including 250 foreigners) and 380 staff. The school has 3 research and teaching centers of high scientific and technological level, which work in the fields of materials and civil engineering (C2MA), environment and risks (CREER), artificial intelligence and industrial and digital engineering (CERIS). It has 12 technological platforms and has 1,600 partner companies.

2. Research project

Title: Augmented simulation for training in water pollution crisis management (STARGATE)

Keywords: Crisis management, Virtual reality, Immersive simulation, Water pollution, Coordination

Water pollution crises are particularly difficult to manage because of their environmental, socio-economic and health impacts. They involve not only technical challenges (detecting pollutants, controlling their spread), but also coordination challenges between actors with varied and often interdependent roles (Bahé, 2010; De Wolf, 2013) These events require rapid decision-making based on fragmentary/parcel or uncertain information, in a context where pollution and ecosystem dynamics can evolve rapidly.

Learning in a real and simulated training environment helps to prepare for complex situations (Fréalle, 2018; Secheppet, 2020). Today, however, the training tools available (Fréalle, 2018; Richard et al., 2023) do not capture the full complexity of these crises. Current simulations, often static or limited in their ability to react to unforeseen events, do not provide sufficient immersion to effectively train crisis managers (Lapierre & Fréalle, 2020). What's more, the technical specificity of aquatic pollution (diffusion of pollutants in water and air, impact on flora and fauna, long-term effects) makes it difficult to develop pedagogically relevant and realistic scenarios (Floch et al., 2012).

STARGATE, the project of which this thesis is a part, aims to fill this gap by developing an innovative augmented simulation, based on virtual reality (VR) and dynamic scenarios, to enable immersive and reactive training in water pollution crisis management.

This thesis is an innovative project exploring new approaches to managing water pollution crises by integrating virtual reality (VR) into training. By simulating immersive, interactive scenarios, it aims to improve learning and decision-making for crisis managers by providing them with a shared, realistic vision of situations in the field, offering dynamic situations where users' actions influence the course of the crisis, thus going beyond conventional static training.

The objectives are to (1) propose immersive crisis simulations to increase management credibility and facilitate decision-making applied to water pollution; (2) develop a suitable self-feeding scenario generation method; (3) study the interoperability and coordination of the players involved in a water pollution situation; (4) anticipate future crises.

The steps identified to complete this thesis project are as follows:

- State of the art on the management of accidental water pollution, crisis management training and the role of virtual reality in this training,

- Design of aquatic pollution scenario generation methods using adapted tools such as generative AI,
- Development of a VR simulation environment,
- Modelling of interactions between actors,
- Testing on real sites,
- Proposal of a crisis anticipation approach.

This project mobilizes interdisciplinary skills: crisis management, engineering sciences, social sciences. This unprecedented synergy enables real-time adaptive simulations, paving the way for innovative methodologies.

The project will be tested at pilot sites in Brest and Montpellier, in collaboration with CEDRE.

3. Team supervision and PhD registration

Research & Teaching Center: CREER

Team: EUREQUA, Laboratoire des Sciences des Risques

PhD school: ED 583 Risques et Société

This thesis is in line with the research themes of the following researchers:

- Pr. Laurent APRIN of the Laboratoire des Sciences des Risques at IMT Mines Alès, France (researcher on experimental and numerical studies of the physico-chemical behavior of chemical pollutants in aquatic environments),
- Dr. Noémie Fréalle, Laboratoire des Sciences des Risques, IMT Mines Alès, France (researcher in the field of crisis management training, specializing in crisis simulation animation and the human factor),
- Dr. Mélanie Secheppet from the Laboratoire des Sciences des Risques at IMT Mines Alès, France (researcher in the field of educational sciences, specializing in activity analysis applied to crisis management),
- Dr. Florian Tena-Chollet from the Laboratoire des Sciences des Risques at IMT Mines Alès, France (researcher in the field of crisis management training, specializing in interactive edutainment devices).
- Dr. HDR Stéphane Le Floch, Head of the Research Department at CEDRE, Brest, France, (researcher in characterizing the degradation of chemical pollutants in aquatic environments).

4. Candidate profile

The ideal candidate is a general engineer or Master 2 in research with a background in risk and crisis management. They should have a keen interest in social sciences and virtual reality scenario modeling. Expected skills include:

- Knowledge of aquatic pollution management and crisis management
- Project management skills,

- Bibliographic research, document monitoring,
- Writing skills,
- Affinity with virtual reality tools,
- Sensitivity to environmental issues,
- Analytical and collaborative spirit.

5. Contacts

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