

PhD CIFRE in Graph-Based Deep Learning

## for 3D Time-Dependent Computational Applied Mechanics

We invite outstanding candidates to apply for a PhD CIFRE project at the intersection of applied mathematics, computational mechanics and artificial intelligence. This doctoral CIFRE program is a unique opportunity to deliver advances that will help industry enhance competitiveness, limit physical test and trial testing, reduce energy consumption, and gain deeper insight into complex manufacturing processes.

Indeed, conventional finite element simulations are indispensable for ensuring quality and precision in engineering manufacturing. However, in many industrial settings, the same process is simulated repeatedly with variations, an approach that is both inefficient and redundant. If we could instead learn from each simulation and build models that generalize across similar configurations, we would unlock a major leap forward in efficiency and insight. This is particularly valuable in aerospace, automotive, and energy sectors, where simulation plays a central role in design, optimization, and quality assurance.

This PhD will tackle two major challenges at the core of next-generation simulation. First, it aims to overcome the persistent reliance on oversimplified 2D and static models by advancing toward fully 3D, time-dependent simulations that reflect the true complexity of industrial forming processes (computational solid and fluid mechanics). Second, it seeks to design and deploy innovative AI-driven methodologies—specifically Graph Neural Networks (GNNs) for mesh-based learning, Transformer architectures for capturing long-range temporal dependencies, and physics-informed training to ensure consistency with fundamental physical laws.

The PhD will be hosted at CEMEF CNRS research center of Mines Paris – PSL, located in the heart of Sophia Antipolis, Europe's premier technology park on the French Riviera. With over 200 researchers, engineers, and doctoral candidates, CEMEF is internationally recognized for its expertise in computational mechanics, materials processing, and scientific computing. This project is carried out in close collaboration with Transvalor, a pioneering company in industrial software development, renowned for its high-performance simulation tools used across aerospace, automotive, and energy sectors.

The PhD is expected to start on October 1st, 2025. Highly qualified and motivated candidates are invited to submit their CV to Prof. Elie Hachem at elie.hachem@minesparis.psl.eu

Contact: <u>elie.hachem@minesparis.psl.eu</u> and jose.alves@transvalor.com