- Projet weirdo-AI
- Projet propose par le département Mast de l’Université Gustave Eiffel,
- en collaboration avec le department of structural engineering and building materials, Ghent University (roman.wanwendner@ugent.be)
- Tuteur du stage : jean-michel.torrenti@univ-eiffel.fr
- Filière visée : Datascience et intelligence artificielle
- Présentation générale du sujet

Delayed strains of concrete structures (creep and shrinkage) are an important source of problems for some bridges because of possible deflections that are larger than predicted in the design phase. This not only concerns individual bridges such as e.g. de Savines bridge (see photo below) but represents a world-wide problem with potentially huge economic impact affecting also high-rise buildings through differential creep. In one case (Palau) there was a collapse of the bridge (Bazant et al., 2011). In order to predict these strains, construction design codes (for instance the new Eurocode 2) use relations in which the parameters are fitted on laboratory test with old techniques. Here it is proposed to apply physics-based deep learning to improve the process. Indeed, it is possible to combine insights into the physical and chemical mechanisms to extract from the abundance of available experimental data covering different sizes, mix design and environmental conditions more accurate extrapolations of the long-term behaviour of concrete. So, it is possible to use deep learning coupled with this physical behaviour to optimize the parameters of the relations in current construction codes, thus decreasing uneconomic conservatism while ensuring safety and serviceability.

Deflections of the Savines bridge

- Objectif du projet

The first objective of the project is to define how the quality of the fit is objectively quantified. This is a real challenge because delayed strains are measured in the laboratory over several weeks while the service life of a bridge is at least 100 years. Next to the logarithmic nature of creep (deformation rate is decaying with time) experimental data is often incomplete, may contain experimental errors and is typically biased towards specific mix designs, specimen geometries and environmental conditions that are easy to test in the laboratory but do not necessarily coincide with practical applications.

Then, using artificial intelligence technique coupled with the physics-based structure of the relations, the parameters of the prediction model will be optimized. The results will be firstly compared with subsets of a database of laboratory tests and currently available prediction models.

Finally, the approach will be tested directly on deflection measurements of real structures (bridges and vessels of nuclear power plants).

- Bibliographie

Bažant, Z. P.; Hubler, M.; and Yu, Q., “Excessive Creep Deflections: An Awakening,” Concrete International, V. 33, No. 8, Aug. 2011, pp. 44-46.