Grégoire Allaire has been a professor at École Polytechnique (France) since 2000, as well as Scientific Advisor for the French Atomic Energy Commission (CEA) since 1997.

He graduated from École Polytechnique in 1986 and obtained his Ph.D. in Mathematics from Université Pierre et Marie Curie (UPMC Paris VI) in 1989, defending his thesis on "Homogenization of Navier-Stokes equations". This work would influence the rest of his academic career. Indeed, after his Ph.D., during his period at the Courant Institute of New York University and in his few years as a researcher at the CEA, he worked mainly on two subjects: homogenization theory and optimization. Regarding the former, he studied double-scale homogenization, with notable applications to Darcy's and Navier-Stokes' equations in porous media and other mixtures. Regarding optimization, his works included optimal bounds of mixtures and optimal design, using shape or topology optimization. Grégoire Allaire then obtained his Habilitation à Diriger des Recherches (HDR) in 1993 from UPMC Paris VI, after which he became part-time professor at Laboratoire d'Analyse Numérique in the same university. There, he resumed his work on homogenization and optimization, especially regarding multi-scale convergence and structural optimization. In 1997, he became Professor at the Laboratoire d'Analyse Numérique and a part-time associate professor at École Polytechnique. In the same year, he also became Scientific Advisor for CEA, which he still is. Afterward, he left UPMC and obtained his current position as Professor at École Polytechnique in 2000. Since then, he has been working on homogenization, optimization, and numerical analysis. The applications of his work include convection-diffusion-reaction phenomena in porous media, spectral problems in fluid-structure interactions, homogenization of the Schrödinger equation with time-oscillating potentials, and optimal microstructures, among many others. Regarding the numerical tools, he has especially studied the level-set method, finite elements and volumes (and their coupling).

Grégoire Allaire has also published 8 books, mainly about numerical analysis (from theoretical foundations involving functional analysis to numerical methods such as finite differences, elements, or volumes) and optimization (geometry, shape, and topology optimization) and more than 200 scientific articles on international journals.

The Scientific Committee of the Levi-Civita Prize in Mechanical and Mathematical Sciences has found especially impressive the paper Allaire, G. (1992). Homogenization and two-scale convergence. SIAM Journal on Mathematical Analysis, 23(6), 1482-1518.

In this paper, Grégoire Allaire discovers and exploits the enormous potentialities of the definition of two-scale convergence due to Nguetseng. This kind of convergence is extremely useful in giving a rigorous mathematical meaning to the concept of convergence of sequences of oscillating functions. One of the most important properties of this notion of convergence consists in the fact that bounded sequences in L2 are proven to be relatively compact with respect to this new type of convergence. Moreover, GA proves an extremely useful corrector-type theorem that allows, under suitable assumptions, to replace a converging sequence by its "two-scale" limit, up to a strongly convergent remainder in L2. These results have proven especially useful, among many other applications, for the homogenization of partial differential equations whose coefficients are oscillating periodically.

Showing the peculiar sensitivity of French applied mathematicians to “concrete” applications, the many works of Grégoire Allaire have proven the power and effectiveness of the two-scale convergence method in many cases, starting from the homogenization of both linear and nonlinear second-order elliptic equations.

Two-scale convergence has been recently recognized as an essential tool for solving an important problem of homogenization of microstructures exhibiting high contrast in geometry and stiffnesses. Indeed, using the theorems deduced in the theory of two-scale convergence, it has been possible to prove that some microstructures behave at the macro-level as second gradient continua.

For the remarkable impact of his work on the scientific community working in homogenization, the Scientific Committee of the Levi-Civita Prize in Mechanical and Mathematical Sciences is honored to propose Grégoire Allaire as a recipient of the 2020 edition of the prize.