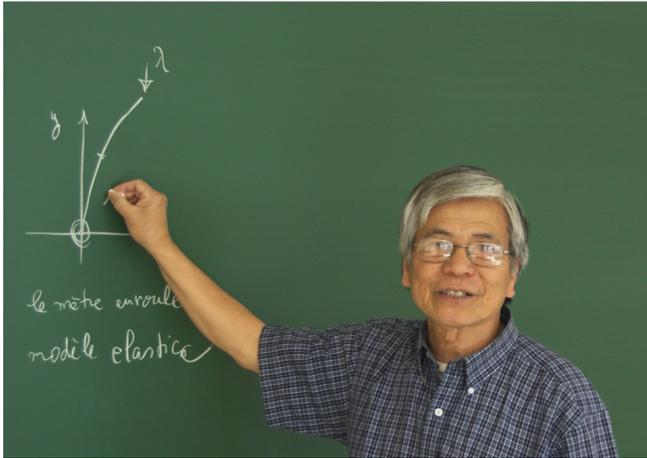


In Memoriam of Nguyen Quoc Son (1944 – 2021)



Nguyen Quoc Son (Son to his family and friends) was born to a family of eight children in 1944, in HaiDuong, Vietnam. Originally from the north, his family left Hanoi in 1954 and went south to Saigon (now Ho-Chin-Minh City), where Son received his high school education and a Baccalauréat degree in 1962. His talent allowed him to leave his war-torn country and obtain a merit scholarship offered by France to study in Paris. His first academic step began with the preparation classes for engineering schools (Math-Sup & Math-Spé) at the Lycée Saint-Louis in Paris. He passed the entrance exam at the Ecole Polytechnique in 1964, after a highly selective competition, and following his graduation in 1966, he obtained his Master's degree from Ecole Nationale des Ponts et Chaussées in 1968, two of the most prestigious engineering schools of France.

His professional career started in 1968 as a civil engineer at the Compagnie Grands Travaux de Marseille, one of the most important firms of civil engineering of France at the time. However, after having designed a lot of bridges and of highway junctions, Son realized that his life's call was elsewhere: he was particularly attracted by the new and exciting research in the fields of Theoretical Mechanics, Applied Mathematics and Computer Sciences. In 1970 he decided to write to Professor Jean Mandel, the founder in 1961 of LMS (Solid Mechanics Laboratory), Polytechnique's first research laboratory, to ask for a possibility to study Convex Analysis in Mechanics. The answer was naturally an enthusiastic "yes" and thus began Son's life-long academic career at LMS as a CNRS (Centre National de Recherche Scientifique, France's State research establishment) researcher.

At this time, the mathematical theory of plasticity was in full effervescence with the development of Convex Analysis and with the early stages of the Finite Element Method. Under the famous heritage of the previous generations of the LMS in Plasticity (Mandel school) and under the supervision of Professor Radenkovic, Son had the opportunity to contribute to the new approach pioneered in the works of Biot, Moreau and Germain. His doctoral thesis, *Contribution to the Theory of Hardening Plasticity*, defended in 1973, developed two main points. First, the introduction of the class of *generalized standard materials* (GSM) in which the behavior of materials is described by two potentials, the energy and the dissipation potentials in relation with thermodynamic considerations. The case of perfect and hardening plasticity was discussed in this framework for material and structural responses, in particular for the derivation of existence and uniqueness theorems and for the stability and bifurcation criteria in quasi-static deformations. This approach is by now well known in the literature and adopted in most courses and textbooks in Plasticity. The second far-reaching idea of the thesis concerned computational methods in Plasticity. The nonlinear governing equations of Plasticity can only be solved numerically by successive iterations and the method of double projection was originally proposed in Son's thesis, a first projection on statically admissible fields through an elastic prediction, followed by a projection on the plastic criterion; his method appears now in most computer codes under the name of *radial return or closest-point algorithm*.

The 1970s were the golden years for the development of Fracture Mechanics as motivated by safety problems in the growing fields of aeronautics and nuclear energy. The LMS had one of the leading teams of France in this field. Son's contribution followed this high tide by his original interpretation in the GSM framework, on the derivation of the driving force, of the temperature and heat source analysis in relation with infra-red imaging.

Stability and bifurcation analysis, inspired by the works of Koiter and Hill in Elasticity and Plasticity respectively, was next and became one of Son's favorite subjects. The derivation of stability and non-bifurcation criteria for dissipative systems, covering time-independent behavior phenomena such as plasticity, brittle fracture, brittle damage and frictional contact was given in a unified framework and in a harmonious combination of theoretical considerations and practical applications. For example, the interpretation of the phenomenon of brake squeal as a dynamic instability induced by frictional contact was one of Son's best known results.

Directeur de Recherche CNRS since 1978, Son has been also a *faculty member* of the Mechanical Engineering Department of Ecole National des Ponts et Chaussées (1975-1986) and of the Mechanics Department of the Ecole Polytechnique (1982-2004). At LMS, Son has supervised the Ph.D. thesis of 20 students. Moreover, he was a great inspiration and helped a younger generation of researchers in mechanics through advice and collaborations.

Nguyen Quoc Son is the author or co-author of about 130 papers and 5 books dealing with plasticity, thermodynamics, fracture mechanics, stability and bifurcation, frictional contact and numerical methods. His book *Stability and Nonlinear Solid Mechanics* (Wiley, 2000) gives a good survey of these topics. His works have been honored by awards from the Académie des Sciences (1978 – Arthur Dufay, for standard generalized materials formulation, 2007– Grand Prix Jaffé for stick-slip waves) and from the CNRS by the Silver Medal in 1988, for his seminal contributions to the understanding of instability and failure phenomena in solids and structures.

His friends and colleagues will always remember a gentle man with a persistent smile who radiated kindness. A very discrete person and passionate about his work, the extreme antipode of a careerist, he never talked about himself and his achievements, leaving it to others to judge the quality of his work. It is perhaps these features of his character that prevented him from obtaining a recognition commensurate with the importance of his contributions.

Son had the experience of a man who has seen the atrocities of war and whose family paid a heavy price (siblings who died at sea or suffered long prison terms) but he was lucky to escape through merit and hard work. He tried to give back to his country by helping in the last twenty years bright Vietnamese students to become students at Ecole Polytechnique and by organizing research collaborations and conferences in his country of birth.

His refuge was his work and above all his family: an excellent and immensely helpful wife, two children that he was justifiably very proud of and grandchildren that he adored. His sudden death is a great loss for his family, friends and colleagues. But Son will continue to live among us, as long as we live and even beyond, through his seminal contributions to our field and as an example to follow.

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