MATHEMATICAL MODELS FOR CONTACT PROCESSES

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In this talk, I will provide and overview of the impressive progress made in the last 25 years in modeling, analysis, and computer simulations of various aspects of processes related to contact between solid bodies, which is the content of the Mathematical Theory of Contact Mechanics. These processes, in addition to contact itself, include friction, wear, adhesion, and material damage. They are critical in breaking systems in cars or airplanes, and important in many engineering and applied settings where parts and components are joined with bolts or adhesives. Indeed, the deterioration of such contacts may cause the systems to have reduced reliability and even malfunction and breaking.

The mathematical interest lies in the fact that these processes are modeled with nonlinear non-smooth differential inclusions that are prescribed on the boundaries of the domains.The talk will describe how the need to analyze such complex models led to the development of new mathematical ideas and tools. In particular, the use of subdifferentials that leads to differential inclusions, existence theorems for variational inequalities, and pseudomonotone operators. Thus, we were able to establish the existence, and sometimes uniqueness of weak or variational solutions to various contact problems. Moreover, these new tools allowed us to study models for more complex processes. The interaction between complex models and mathematical analysis led to very fruitful cross-fertilization.

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