Generalized Solutions of First Order PDEs: The Dynamical Optimization Perspective (Systems & Control: Foundations & Applications)

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Hamilton-Jacobi equations and other types of partial differential equa tions of the first order are dealt with in many branches of mathematics, mechanics, and physics. These equations are usually nonlinear, and func tions vital for the considered problems are not smooth enough to satisfy these equations in the classical sense. An example of such a situation can be provided by the value function of a differential game or an optimal control problem. It is known that at the points of differentiability this function satisfies the corresponding Hamilton-Jacobi-Isaacs-Bellman equation. On the other hand, it is well known that the value function is as a rule not everywhere differentiable and therefore is not a classical global solution. Thus in this case, as in many others where first-order PDE's are used, there arises necessity to introduce a notion of generalized solution and to develop theory and methods for constructing these solutions. In the 50s-70s, problems that involve nonsmooth solutions of first order PDE's were considered by Bakhvalov, Evans, Fleming, Gel'fand, Godunov, Hopf, Kuznetzov, Ladyzhenskaya, Lax, Oleinik, Rozhdestven ski1, Samarskii, Tikhonov, and other mathematicians. Among the inves tigations of this period we should mention the results of S.N. Kruzhkov, which were obtained for Hamilton-Jacobi equation with convex Hamilto nian. A review of the investigations of this period is beyond the limits of the present book. A sufficiently complete bibliography can be found in [58, 126, 128, 141].

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