1096-49-1101 **Robert J Kipka*** (robert.j.kipka@wmich.edu), Robert J. Kipka, 4433 Everett Hall, Western Michigan University, Kalamazoo, MI 49008-5248, and **Yuri S. Ledyaev**. *Optimality Conditions for Problems of Geometric Optimal Control.* Preliminary report.

Techniques of nonsmooth and variational analysis play an important role in problems of optimization and control. It has been demonstrated that such methods provide effective and natural techniques even in problems for which the data is smooth. To this date, however, nonsmooth and variational techniques have not been developed in the context of optimality conditions for control problems posed on manifolds. We present new work in this direction culminating in a new proof of the Pontryagin Maximum Principle under general assumptions. In the process, we demonstrate that nonsmooth costs and constraints can play a natural role in problems with C^∞-smooth costs or constraints and we present a penalization technique which, subject to a certain constraint qualification, permits the replacement of terminal constraints with a nonsmooth penalty function. Finally, we demonstrate that the success or failure of the constraint qualification corresponds to the presence of normal and abnormal extremals, respectively. (Received September 12, 2013)