Discovery of Singular Points in DAE models

D. E. Schwarz[1] and <u>**R. Lamour**</u>[2]

Abstract: The quality of numerical simulations of DAEs models depends on basic assumptions which exclude singularities. But many of the algorithms used in simulation tools do not check the assumed properties of the DAE. In particular, since the solution may not be unique at singular points, arbitrary solutions may be obtained.

For DAEs, such singularities may occur if the structure or the dimension of the spaces related to the DAE change. Moreover, even though a numerical singularity is not given in a strict mathematical sense, the numerical behavior may be analogous for sensitive problems.

We aim at a characterization of this sensitivity, considering the condition number of a suitable matrix related to the DAE that is constructed using automatic differentiation. We show how this approach, which builds on the projector based analysis, can be applied to properly stated DAEs up to index 2. Illustrative examples are given.

[1] Beuth Hochschule für Technik Berlin
Luxemburger Str. 10, 13353 Berlin, Germany
estevez@beuth-hochschule.de

[2] Humboldt-University of Berlin
Department of Mathematics
Unter den Linden 6, 10099 Berlin, Germany
lamour@math.hu-berlin.de