



HAL
open science

A differential algebraic approach of systems theory

Sette Diop

► **To cite this version:**

Sette Diop. A differential algebraic approach of systems theory. The 28th International Conference on Applications of Computer Algebra (ACA'2023), July 17 – 21, 2023, Warsaw, Poland, The Applications of Computer Algebra Working Group, Jul 2023, Warsaw (POLAND), Poland. hal-04327570

HAL Id: hal-04327570

<https://hal.science/hal-04327570v1>

Submitted on 8 Dec 2023

HAL is a multi-disciplinary open access archive for the deposit and dissemination of scientific research documents, whether they are published or not. The documents may come from teaching and research institutions in France or abroad, or from public or private research centers.

L'archive ouverte pluridisciplinaire **HAL**, est destinée au dépôt et à la diffusion de documents scientifiques de niveau recherche, publiés ou non, émanant des établissements d'enseignement et de recherche français ou étrangers, des laboratoires publics ou privés.

Public Domain

A differential algebraic approach of systems theory

Sette Diop

Université Paris-Saclay, CNRS, CentraleSupélec,
Laboratoire des signaux et systèmes,
Gif sur Yvette, France

Differential algebraic geometry (and differential algebra) [1,2] was earlier recognized as particularly adapted as a language for the description of some of the systems theory problems. See the pioneering works by Jean-François Pommaret [3] and Michel Fliess [4]. In the latter paper the notion of invertibility, which was long studied in the control literature, was given a better clarification. And in the [5] differential algebraic elimination theory was invoked as, not only a better description of questions in the control literature, but a constructive answer, too. One of the fundamental notions of systems theory, that of observability, was also given a differential algebraic geometry description which clarified many aspects of that questions [6]. This contribution is a tentative comprehensive expose of differential algebraic geometry known answers to some of the systems theory questions. The latter include previously mentioned ones, and notions of invariants, structural issues, and constructivity.

References

- [1] J. F. RITT, *Differential Algebra*. American Mathematical Society, Providence, RI, 1950.
- [2] E. R. KOLCHIN, *Differential Algebra and Algebraic Groups*. Academic Press, New York, 1973.
- [3] J. F. POMMARET, *Differential Galois Theory*. Gordon and Breach, New York, 1983.
- [4] M. FLIESS, A note on the invertibility of nonlinear input-output differential systems. *Systems Control Lett.* **4**, 17–32 (1986).
- [5] S. DIOP, Elimination in control theory. *Math. Control Signals Systems* **8**(2), 147–151 (1991).
- [6] S. DIOP, From the geometry to the algebra of nonlinear observability. In *Contemporary Trends in Nonlinear Geometric Control Theory and its Applications*, A. Anzaldo-Meneses, B. Bonnard, J. P. Gauthier and F. Monroy-Perez (eds.), 305–345. World Scientific Publishing Co., Singapore, 2002.