DAE Panel
DOI:10.xxx/xxx-x
Submitted: xx.xx.20xx
Accepted: xx.xx.20xx
Published: xx.xx.20xx

Differential-algebraic equations are no ordinary differential equations

a DAE approach

MAX MUSTER, JANE DOE, AND JOHN Q. PUBLIC

Abstract: Differential-algebraic equations are everywhere ...., which gives a new inside into the theory of differential-algebraic equations.

Keywords: at least three keywords in lower case separated by commas

AMS Subject Classification (2020): at least two classification numbers in lower case separated by commas

1 Introduction

In this article we consider differential-algebraic equations ... and the text goes on goes on goes on goes ...

1.1 Nomenclature

This is an example how the `tabular` environment can be used.

$\mathbb{R}_{\geq 0}$	$= [0, \infty)$
$\mathbf{Gl}_n(\mathbb{R})$	the group of invertible matrices in $\mathbb{R}^{n\times n}$
$\mathscr{L}^\infty_{\text{loc}}(I \to \mathbb{R}^n)$	the set of locally essentially bounded functions $f : I \to \mathbb{R}^n$, $I \subseteq \mathbb{R}$ an interval
$\mathscr{L}^\infty(I \to \mathbb{R}^n)$	the set of essentially bounded functions $f : I \to \mathbb{R}^n$
$\|f\|_\infty$	$= \text{ess sup}_{t\in I}\|f(t)\|$
$\mathscr{W}^{k,\infty}(I \to \mathbb{R}^n)$	the set of k-times weakly differentiable functions $f : I \to \mathbb{R}^n$ such that $f, \dots, f^{(k)} \in \mathscr{L}^\infty(I \to \mathbb{R}^n)$
$\mathscr{C}^k(V \to \mathbb{R}^n)$	the set of k-times continuously differentiable functions $f : V \to \mathbb{R}^n$, $V \subseteq \mathbb{R}^m$
$\mathscr{C}(V \to \mathbb{R}^n)$	$= \mathscr{C}^0(V \to \mathbb{R}^n)$
$f\|_W$	restriction of the function $f : V \to \mathbb{R}^n$ to $W \subseteq V$

Feel free to use your own notation.

2 Equations

Differential equations from multibody dynamics are of the form

$$\begin{aligned} \dot{q}(t) &= v(t), \\ M\big(q(t)\big)\,\dot{v}(t) &= g\big(t,q(t),v(t)\big) + B\big(q(t)\big)u(t), \\ q(0) = q^0 \in \mathbb{R}^n, &\quad v(0) = v^0 \in \mathbb{R}^n, \end{aligned} \tag{1}$$

with

- the generalized mass matrix $M \in \mathscr{C}^1(\mathbb{R}^n \to \mathbf{Gl}_n(\mathbb{R}))$,
- the generalized forces $g \in \mathscr{C}^1(\mathbb{R} \times \mathbb{R}^n \times \mathbb{R}^n \to \mathbb{R}^n)$,
- the input distribution matrix $B \in \mathscr{C}(\mathbb{R}^n \to \mathbb{R}^{n\times m})$.

3 A figure

This is an example of a figure.

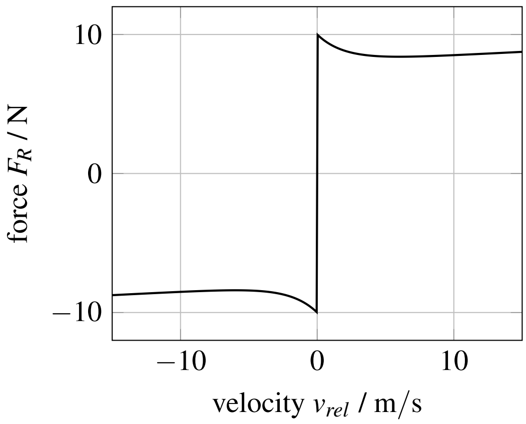

Figure 1. Qualitative graph of sliding friction.

4 Theorems, proofs, etc...

Assumption 4.1. *We assume that ....*

Theorem 4.2. *Let ... Then the index of the differential-algebraic equation* (1) *does not exceed one.*

Proof. Seeking for a contradiction, we assume that the index is larger than one. This however contradicts to the fact that the earth is a sphere. □

Remark 4.3. *A remark goes here.*

Lemma 4.4. *A lemma goes here.*

5 Citation

[1, 6] are books, [3, 4] are journal articles, [2] is contained in a conference proceedings, and [5] is a book chapter.

6 Conclusions

We have considered the problem of ...

Acknowledgement

If you want to acknowledge persons or institutions, you can do so here.

Funding

Please insert a funding statement (if applicable) here.

Data Availability Statement

This field is mandatory. Please include a statement on how the data supporting the results of your article can be accessed. If the submission is not based on data or the data it is based on is restricted (third-party data, legal or ethical constraints), this has to be explained in the data availability statement, too. Ideally, data should be deposited in a FAIR-aligned public repository. A registry to find suitable data repositories is re3data.org. Reciprocal linking of data and the article/contribution through persistent identifiers (e.g. DOIs) is best practice. Appropriate statements are e.g. "The data that support the findings of this study are openly available in [repository name] at `http://doi.org/[doi]`" or "Data sharing is not applicable to this article as no new data were created or analysed in this study.

Underlying and related material

This field is mandatory. If you have other material that supports your findings (e.g. model code) or is closely related to your article (e.g. videos, samples, etc.) deposited on a repository, please include a brief description and the respective DOI(s) here.

Author contributions

This field is mandatory. Please include a statement on authors' contributions according to the CreDIT (`http://credit.niso.org/`) guidelines here. CRediT (Contributor Roles Taxonomy)'s intention is to recognize individual author contributions, reduce authorship disputes, and facilitate collaboration.

Competing interests

This field is mandatory. Competing interests arise when issues outside research may fairly be viewed as impacting the work's neutrality. All potential competing interests must be disclosed ("The authors declare the following competing interests: ..."). If there are no potential competing interests please state "The authors declare that they have no competing interests."

References

[1] K. E. Brenan, S. L. Campbell, L. R. Petzold. *Numerical Solution of Initial-Value Problems in Differential-Algebraic Equations*. Amsterdam: North-Holland, 1989.

[2] C. I. Byrnes, A. Isidori. A frequency domain philosophy for nonlinear systems, with application to stabilization and to adaptive control. Proc. 23rd IEEE Conf. Decis. Control. Vol. 1. 1984:1569–1573.

[3] S. L. Campbell. Linear systems of differential equations with singular coefficients. *SIAM J. Math. Anal.* 1977;8:1057–1066.

[4] C. W. Gear. The simultaneous numerical solution of differential-algebraic equations. *IEEE Trans. Circ. Theory*. 1971;CT-18:89–95.

[5] G. W. Gear, L. R. Petzold. "Differential/algebraic systems and matrix pencils". Matrix Pencils. Ed. by B. Kågström, A. Ruhe. Vol. 973. Lecture Notes in Mathematics. Berlin: Springer-Verlag, 1983.

[6] W. Walter. *Ordinary Differential Equations*. New York: Springer-Verlag, 1998.

Max Muster
Institut für angewandte Mathematik und wissenschaftliches Rechnen
Universität der Bundeswehr München
Werner-Heisenberg-Weg 39
85577 Neubiberg/München, Germany
max.muster@unibw.de

Jane Doe
Institut für Mathematik
Technische Universität Ilmenau
Weimarer Str. 25
98693 Ilmenau, Germany
jane.doe@tu-ilmenau.de

John Q. Public
Institut für Mathematik
Technische Universität Ilmenau
Weimarer Str. 25
98693 Ilmenau, Germany
john.public@tu-ilmenau.de