A WEB-BASED APPLICATION FOR EVALUATING PARAMETER IDENTIFIABILITY OF BIOCHEMICAL MODELS IN POLYNOMIAL FORM

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1 Abstract
State-space models are very often used for the quantitative modelling of biochemical systems. Together with parameter estimation, a necessary and early step in the building of such models is the assessment of identifiability properties: Whether the structure of the model and the available experimental data allow for the determination of a unique value for each of its parameters. The approach taken with structural identifiability attempts to determine the algebraic solvability of the model’s parameters under the assumption of infinite-resolution and error-free data. A model is said to be:

Globally identifiable when its algebraic structure allows for the determination of a single solution to all its parameters.
Locally identifiable when a single global solution cannot be guaranteed but there exist a multitude of solutions which, however, lie isolated in parameter space.
Unidentifiable when at least a single continuous range of solutions is possible.

We present an online application that computes these properties for polynomial models in a completely automated manner.

2 Algorithms

3 Implementation

http://kdbio.inesc-id.pt/~mbs/DynaMo

State variables:
\[ x_1, x_2, x_3 \]
Output variables:
\[ f, y \]
Input variables:
\[ u, v \]
Model state functions (ODEs):
\[
\begin{align*}
x_1' &= (x_1^2 + x_2^2) x_3 + \cos(x_1) \\
x_2' &= x_1^2 + x_2^2 + \tan(x_1) \\
x_3' &= x_1^2 + x_2^2 + \sin(x_1)
\end{align*}
\]
Output functions:
\[ y = x_1 / \sqrt{x_2} \]

Method to use:

- Standard DAISY
- Improved Method

Evaluated Model

RESULT: Not identifiable

This means that there is no set of experimental data that can provide a unique solution for all model parameters, even locally (that is, at least one parameter has always a continuum of possible solutions). In this case, identifiability may only be attained by restructuring the model.

References:
3. G. Bellu et al., A NEW SOFTWARE TOOL TO TEST GLOBAL IDENTIFIABILITY OF BIOLOGICAL AND PHYSIOLOGICAL SYSTEMS, Computer Methods And Programs In Biomedicine 88, 52-61 (2007).