

# Structural Identifiability Toolbox

## ▼ReadMe

This app allows to assess structural identifiability for models defined by systems of parametric Ordinary Differential Equations (ODEs). There are two main "tracks" in this application: **SIAN** (for identifiability of individual parameters) and **Multi- and Single-Experiment Identifiable Combinations** (identifiable combinations).

The SIAN algorithm (<https://github.com/pogudingleb/SIAN>) is presented in the following papers:

- [Global Identifiability of Differential Models](#) (Communications on Pure and Applied Mathematics, Volume 73, Issue 9, Pages 1831-1879, 2020)
- [SIAN: software for structural identifiability analysis of ODE models](#) (Bioinformatics, Volume 35, Issue 16, Pages 2873–2874, 2019)

Algorithms for identifiability of functions of parameters for Single- and Multi-Experiment scenarios are described in

- [Computing All Identifiable Functions of ODE Models](#); for original Maple implementation click [here](#).

To run an example, you can either select one from the drop-down menu next to "Select example system" or enter a custom ode system manually. The results will appear in the Output section at the bottom of the page.

## ►FAQ

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Note: to restart the app or cancel the computation, please reload the webpage. **To save the data, click on "Save Output" button and copy the results from the text window.**

Select an example system: Custom ▼

Or enter a custom model in the field below separated by comma (",") or semicolon (";"). The input can be written in one of two ways (detected automatically):

- Text based:  $dx1/dt = a*x1 + x2*b + u(t)$ ,  $dx2/dt = x2*c + x1$ ,  $y=x2$ . **Note that the input function "u" must be explicitly written with (t) at the end: u(t)**
- Maple based:  $diff(x1(t), t) = a*x1(t) + b*x2(t) + u(t)$ ,  $diff(x2(t), t) = c*x2(t) + x1(t)$ ,  $y(t)=x2(t)$

## ►More about SIAN's functionality

## ►Settings for Individual Parameters (SIAN)

## ►More about Single- and Multi-Experiment Identifiable Combinations functionality

## ▼Settings for Identifiable Combinations

Warning: Initial conditions are not analyzed for Single- or Multi-Experiment Identifiability Combinations.

Check below for Single- or Multi-Experiment Identifiability Combinations

- ☐ Compute Identifiable Combinations
- ☒ Attempt Bypass using SIAN
- ☒ Simplify Combinations
- ☐ Do Not Check Single-Experiment Identifiability
- ☒ Try to Refine Bound
- Using up to  attempts
- ☐ Do not Calculate Bound for # of Experiments

```
dSh/dt = mh * (Sh + Lh + Ih + Rh) - bv * Sh * Iv / (Sh + Lh + Ih + Rh) - mh * Sh,
dLh/dt = bv * Sh * Iv / (Sh + Lh + Ih + Rh) - ah * Lh - mh * Lh,
dIh/dt = ah * Lh - gh * Ih - mh * Ih,
dRh/dt = gh * Ih - mh * Rh,
dSv/dt = mv * (Sv + Lv + Iv) - bh * Sv * Ih / (Sh + Lh + Ih + Rh) - mv * Sv,
dLv/dt = bh * Sv * Ih / (Sh + Lh + Ih + Rh) - av * Lv - mv * Lv,
dIv/dt = av * Lv - mv * Iv,
y1 = Ih / (Sh + Lh + Ih + Rh)
```

Running SIAN:  
-----  
=> Step 0. Extracting states, inputs, outputs, and parameters from the system  
=> Step 1. Constructing the maximal polynomial system  
=> Step 2. Truncating the polynomial system based on the Jacobian condition  
=> Step 3. Assessing local identifiability  
=> Step 4. Randomizing the truncated system  
=> Step 5. Assessing global identifiability



▼Outputs:

Globally Identifiable Parameters  
*Running*

Identifiability of Individual Parameters:

Locally Identifiable Paramters  
 $[ah, av, bh, gh, mh, mv]$

Not Identifiable Parameters  
 $[Ih(0), Iv(0), Lh(0), Lv(0), Rh(0), Sh(0), Sv(0), bv]$

Identifiable Combinations:

Bound on the number of experiments:

Multi-Experient identifiable functions are generated by:

Single-Experiment identifiable functions are generated by:

CPU runtime of SIAN (sec)

CPU runtime of Multi-Experiment Identifiability (sec)

CPU runtime of Single-Experiment Identifiability (sec)

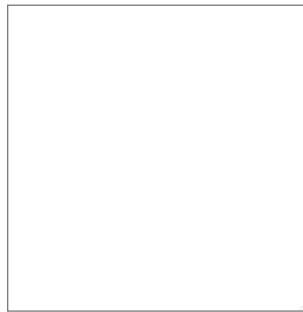
▼ Execution Log:

SIAN log:

```
Using text-based input format:

[diff(Sh(t),t) = mh*
(Sh(t)+Lh(t)+Ih(t)+Rh(t))-
bv*Sh(t)*Iv(t)/(Sh(t)+Lh(t)+Ih(t)+Rh(t)
))-mh*Sh(t), diff(Lh(t),t) =
bv*Sh(t)*Iv(t)/(Sh(t)+Lh(t)+Ih(t)+Rh(t)
))-ah*Lh(t)-mh*Lh(t), diff(Ih(t),t) =
-gh*Ih(t)-mh*Ih(t)+ah*Lh(t),
diff(Rh(t),t) = gh*Ih(t)-mh*Rh(t),
diff(Sv(t),t) = mv*
(Sv(t)+Lv(t)+Iv(t))-
bh*Sv(t)*Ih(t)/(Sh(t)+Lh(t)+Ih(t)+Rh(t)
))-mv*Sv(t), diff(Lv(t),t) =
bh*Sv(t)*Ih(t)/(Sh(t)+Lh(t)+Ih(t)+Rh(t)
))-av*Lv(t)-mv*Lv(t), diff(Iv(t),t) =
-mv*Iv(t)+av*Lv(t), y1(t) =
Ih(t)/(Sh(t)+Lh(t)+Ih(t)+Rh(t))]
```

Multi-Experiment Identifiability Log



Single-Experiment Identifiability Log

