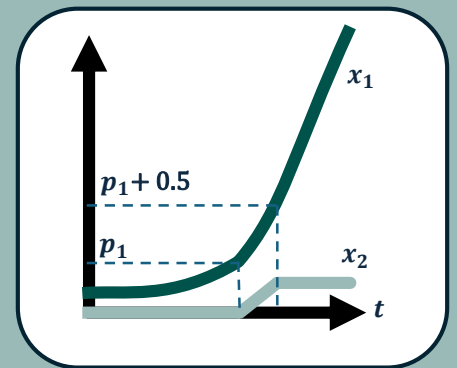


# Introductory Course on Implicitly Switched ODEs

## Theory and Hands-On Practical with IFDIFF

### ? *Why switched ODEs?*

Implicitly switched ODEs occur frequently in differential equation codes that contain IF conditionals or other sources of discontinuities. Their correct treatment requires profound knowledge on solution theory and computation.



### *What is the course content?*

The first part of the workshop covers the mathematical theory of implicitly switched ODEs, including Filippov solutions. The second part consists of a hands-on practical on IFDIFF, a software for solving and sensitivity generation of switched ODEs that automatically generates required switching functions, relieving the modeler of mathematical details.

More about IFDIFF



<https://t1p.de/IFDIFF>

### *Who can participate?*

Students and members of Heidelberg University and other universities as well as interested modelers from industry. Some background on numerical methods for ODEs is helpful.

Participation is free of charge.  
HGS MathComp fellows can receive 1 ECTS point.

Organizers: Kilian Folger, Lev Gromov, Michael Strik  
Project PErFDiff: Andreas Sommer

*Register here!*

<https://t1p.de/ifdiff-course>

**Wednesday, June 26, 2024 • 9-16h (s.t.)**

Mathematikon • CIP-Pool 1 • 3rd Floor

Im Neuenheimer Feld 205 • 69120 Heidelberg



# Introductory Course on Implicitly Switched ODEs

Wednesday, June 26, 2024 • CIP Pool 1 • Mathematikon

## Course program

### Theoretical part [9-12h]

- A canonical example of implicitly switched ODE
- Introduction to ODE theory
- Numerical integration: Explicit & implicit one-step methods
- Sensitivities: Derivatives w.r.t. to initial value and parameters

[Break with coffee and cookies]

- A glimpse on the theory of switched ODE
- Switching functions and transversality condition

[Break with coffee and cookies]

- Filippov solutions
- Behind the scenes: Switched ODE with IFDIFF

### Lunch break with finger food and beverages [12-13h]

### Practical part [13-16h]

- Review of numerical ODE solving in MATLAB
- Solving switched ODE problems with IFDIFF:
  - Switched ODE from a modelling perspective
  - From mathematical formulation to Matlab code
  - Diagnosing and avoiding common mistakes
  - Comparing IFDIFF to naïve solution of switched ODE

[Coffee and cookies always available]