

ctsmr package - Continuous Time Stochastic Modelling in R

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ctsmr (<http://ctsm.info>) is a new *R* package providing a framework for identifying and estimating stochastic grey-box models. **ctsmr** is the continuation of CTSM[4]. A grey-box model consists of a set of stochastic differential equations coupled with a set of discrete time observation equations, which describe the dynamics of a physical system and how it is observed. The grey-box models can include both system and measurement noise, and both nonlinear and nonstationary systems can be modelled using **ctsmr**.

The estimation is based on one or more independent datasets using maximum likelihood (or maximum a posteriori estimation) and Kalman filtering. **ctsmr** automatically distinguishes between linear or nonlinear stochastic state space formulations and applies either the regular or extended Kalman filter.

A model in **ctsmr** is built around `ReferenceClasses`. State and measurement equations are added sequentially forming a complete model. The model is subsequently translated into Fortran and compiled for speed. The likelihood function is usually optimized using a quasi Newton method using finite difference approximations of the gradient. The gradient is computed in parallel using *OpenMP*.

CTSM and **ctsmr** has been successfully applied to a range of applications. A few examples are: heat dynamics of thermal systems (walls and buildings[1], BIPV[5]), solar and wind power forecasting[3], solar-activity[7], pharmacokinetic/pharmacodynamic[2] and rainfall-runoff forecasting[6].

The upcoming version of **ctsmr** includes sensitivity analysis for computing the gradients and a mixed-effects extension.

References

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