

Function	turnerModel()
File version	1.0
Last updated	6 December 2020
Associated source code file	www.github.com/bsh2/Fitness-Fatigue-Models/tree/docs-and-utilities/software/utilities/turnerModel.R
Dependencies (packages required)	caret, GA, parallel, foreach, iterators, doParallel, doRNG, deSolve
Functionality	Simultaneously solve and fit the non-linear variant of the original FFM system for a set of experimental data. Includes estimation of initial model conditions. Optimisation performed by tuneable genetic algorithm with stochastic local search.
Underlying model: A system of non-linear differential equations Turner et al. (2017)	$\hat{p}(t) = p^* + k_g g(t) - k_h h(t),$ $g'(t) = \omega(t) - \frac{1}{\tau_g} g(t)^\alpha$ $h'(t) = \omega(t) - \frac{1}{\tau_h} h(t)^\beta$ <p>Where:</p> $g(t) \geq 0, h(t) \geq 0, k_h \geq k_g > 0$

1. Usage

```
turnerModel(inputData, constraints, doTrace = FALSE, initialWindow = NULL,
testHorizon= NULL, expandRate = NULL, doParallel = FALSE, maxIt = 1000, popSize =
120, gaSelection = "gareal_tourSelection", gaCrossover = "gareal_blxCrossover",
gaMutation = "gareal_rsMutation", gaElitism = 7.5)
```

2. Arguments

Argument	Required	Category	Default	Details
inputData	Yes	Core arg.	No default	Data frame. Contains time-series data in sequential order. Three columns in order from left to right: "days", "performances", "loads". Data ordered in equal time steps, controlled by the "days" column (i.e. 1 day). Example dataset available in repository. 0 values used in loads column to represent no training on a given day. NA values in performance column to represent no observed measure on a given day.

Argument	Required	Category	Default	Details
constraints	Yes	Core arg.	No default	<p>Box constraints for the parameter values. Supplied as a data frame with two columns ("lower", "upper"), each containing non-named numeric values in a specific order.</p> <pre>data.frame("lower" = c(), "upper" = c())</pre> <p>Where order of the values in the lower and upper bound vectors comprising the data frame are as follows:</p> $k_g, k_h, \tau_g, \tau_h, \alpha, \beta, p(0), g(0), h(0)$
doTrace	No	Optimisation	TRUE	TRUE/FALSE argument. Controls whether optimisation output is printed to the console
initialWindow	No	Cross-validation	NULL	Initial model training window size for out-of-sample walk forward method (expanding window). Supplied as a percentage value (without the % sign). If NULL, default will be set to 60% of the data (i.e. <code>initialWindow = 60</code>)
testHorizon	No	Cross-validation	NULL	Walk forward testing size. Supplied as percentage value (without % sign). If NULL, default will be set to 20% (i.e. <code>testHorizon = 20</code>)
expandRate	No	Cross-validation	NULL	Walk forward increment rate. Supplied as percentage value (without % sign). If NULL, default will be set to 4% (i.e. <code>expandRate = 4</code>)
doParallel	No	Optimisation	FALSE	TRUE/FALSE argument. Controls whether the optimisation will be split across available logical nodes.
maxIt	No	Optimisation	1000	The maximum number of iterations to run before the GA search is halted
popSize	No	Optimisation	120	The population size

Argument	Required	Category	Default	Details
gaSelection	No	Optimisation	"gareal_tourSelection"	The selection function (i.e. function that generates a new population of individuals from the current population probabilistically according to individual fitness). See GA package documentation for other options
gaCrossover	No	Optimisation	"gareal_blxCrossover"	The crossover function (i.e. a function which forms offsprings by combining part of the genetic information from their parents). See GA package documentation for other options
gaMutation	No	Optimisation	"gareal_rsMutation"	The mutation function (i.e. a function which randomly alters the values of some genes in a parent chromosome). See GA package documentation for other options
gaElitism	No	Optimisation	7.5	The number of best fitness individuals to survive at each generation. By default top 7.5% will survive at each iteration.

3. Value (output)

Returns an object of class list, with the following slots

Slot	Name	Type	Relates to	Contains
1	mainSet	List	Primary fitted model	Further objects: Summary information (summary), parameters found (parameters), model fit metrics (metrics), model prediction series (predictions), raw optimisation data (optim)
2	crossValidation	List	Cross validation slice data	Further objects: Summary information (summary), model fit metrics across the CV slices (metrics), parameter values across slices (parameters), prediction series across slices (predictions), raw slice data (raw)