# Continuous random walk model of order 2 (CRW2)

### Parametrization

The continuous random walk model of order 2 (CRW2) for the Gaussian vector  $\mathbf{x} = (x_1, \dots, x_n)$  is described in the GMRF-book chapter 3. It is an exact representation of the continuous CRW2 model augmented with its derivaties. The use its the same as for RW2.

## Hyperparameters

The precision parameter  $\tau$  is represented as

$$\theta = \log \tau$$

and the prior is defined on  $\theta$ . Note that  $\tau$  is the precision for the first order increments.

## Specification

The CRW2 model is specified inside the f() function as

```
f(<whatever>, model="crw2", values=<values>, hyper = <hyper>)
```

The (optional) argument values is a numeric or factor vector giving the values assumed by the covariate for which we want the effect to be estimated. See next example for an application.

## Hyperparameter spesification and default values

```
\operatorname{\mathbf{doc}} Exact solution to the random walk of order 2
```

## theta

hyper

```
hyperid 6001
name log precision
short.name prec
prior loggamma
param 1 5e-05
initial 4
fixed FALSE
to.theta function(x) log(x)
from.theta function(x) exp(x)
```

```
constr TRUE
```

```
nrow.ncol FALSE
```

augmented FALSE

aug.factor 2

aug.constr 1

n.div.by

n.required FALSE

```
set.default.values FALSE
min.diff 1e-04
pdf crw2
```

# Example

```
n=100
z=seq(0,6,length.out=n)
y=sin(z)+rnorm(n,mean=0,sd=0.5)
data=data.frame(y=y,z=z)

formula=y~f(z,model="crw2")
result=inla(formula,data=data,family="gaussian")
```

#### Notes

- The CRW2 is a intrinsic with rank deficiency 2.
- The CRW2 model for irregular locations are supported although not described here.
- The  $\frac{n-r}{2}\log(|R|^*)$ -part (with r=2) of the normalisation constant is not computed, hence you need to add this part to the log marginal likelihood estimate, if you need it.
- Usually, you may want to use the model RW2 instead.