

## 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 derivatives. The use is 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 specification and default values

`doc` Exact solution to the random walk of order 2

`hyper`

`theta`

`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 0.001
```

```
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.