# Package 'spNNGP'

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**Title** Spatial Regression Models using Nearest Neighbor Gaussian Processes

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**Author** Andrew O. Finley <finleya@msu.edu>, Abhirup Datta <abhidatta@jhu.edu>, Sudipto Banerjee <sudipto@ucla.edu>

**Maintainer** Andrew Finley <finleya@msu.edu>

**Depends** R (>= 1.8.0), coda, Formula

**Description** Fits Gaussian univariate Bayesian spatial regression models using Nearest Neighbor Gaussian Processes (NNGP).

**License** GPL (>= 2)

**Encoding** UTF-8

**URL** http://blue.for.msu.edu/software.html

**Repository** CRAN

**NeedsCompilation** yes

## R topics documented:



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rNNGP *Function for fitting univariate Bayesian spatial regression models*

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### Description

The function rNNGP fits Gaussian univariate Bayesian spatial regression models using Nearest Neighbor Gaussian Processes (NNGP).

## Usage

```
rNNGP(formula, data = parent.frame(), coords, n.neighbors,
      starting, tuning, priors, cov.model,
      n.samples, n.omp.threads = 1, verbose=TRUE, n.report=100, ...)
```

## Arguments

| | |
|---|---|
| formula | a symbolic description of the regression model to be fit. See example below. |
| data | an optional data frame containing the variables in the model. If not found in data, the variables are taken from environment(formula), typically the environment from which rNNGP is called. |
| coords | an $n \times 2$ matrix of the observation coordinates in $R^2$ (e.g., easting and northing). |
| n.neighbors | number of neighbors used in the NNGP |
| starting | a list with each tag corresponding to a parameter name. Valid tags are beta, sigma.sq, tau.sq, phi, and nu. The value portion of each tag is the parameter's starting value. |
| tuning | a list with each tag corresponding to a parameter name. Valid tags are sigma.sq, tau.sq, phi, and nu. The value portion of each tag defines the variance of the Metropolis sampler Normal proposal distribution. |
| priors | a list with each tag corresponding to a parameter name. Valid tags are sigma.sq.ig, tau.sq.ig, phi.unif. Variance parameters, simga.sq and tau.sq, are assumed to follow an inverse-Gamma distribution, whereas the spatial decay phi and smoothness nu parameters are assumed to follow Uniform distributions. The hyperparameters of the inverse-Gamma are passed as a vector of length two, with the first and second elements corresponding to the *shape* and *scale*, respectively. The hyperparameters of the Uniform are also passed as a vector of length two with the first and second elements corresponding to the lower and upper support, respectively. |
| cov.model | a quoted keyword that specifies the covariance function used to model the spatial dependence structure among the observations. Supported covariance model key words are: "exponential", "matern", "spherical", and "gaussian". See below for details. |
| n.samples | the number of posterior samples to collect. |
| n.omp.threads | a positive integer indicating the number of threads to use for SMP parallel processing. The package must be compiled for OpenMP support. For most Intel-based machines, we recommend setting n.omp.threads to up to the number of hyperthreaded cores. |
| verbose | if TRUE, model specification and progress of the sampler is printed to the screen. Otherwise, nothing is printed to the screen. |
| n.report | the interval to report Metropolis sampler acceptance and MCMC progress. |
| ... | currently no additional arguments. |

## Details

Model parameters can be fixed at their starting values by setting their tuning values to zero.

The *no nugget* model is specified by setting tau.sq to zero in the starting and tuning lists.

## Value

An object of class rNNGP, which is a list comprising:

| | |
|---|---|
| p.beta.samples | a coda object of posterior samples for the regression coefficients. |
| p.theta.samples | a coda object of posterior samples for covariance parameters. |
| run.time | execution times for building the nearest neighbor index and MCMC sampler reported using proc.time(). |

The return object will include additional data used for subsequent prediction and/or model fit evaluation.

## Author(s)

Andrew O. Finley <finleya@msu.edu>,
Abhirup Datta <abhidatta@jhu.edu>,
Sudipto Banerjee <sudipto@ucla.edu>

## References

Datta, A., S. Banerjee, A.O. Finley, and A.E. Gelfand. (2016) Hierarchical Nearest-Neighbor Gaussian process models for large geostatistical datasets. Journal of the American Statistical Association, 111:800-812.

## Examples

```
## Not run:

rmvn <- function(n, mu=0, V = matrix(1)){
  p <- length(mu)
  if(any(is.na(match(dim(V),p))))
    stop("Dimension problem!")
  D <- chol(V)
  t(matrix(rnorm(n*p), ncol=p)
}

set.seed(1)

n <- 5000
coords <- cbind(runif(n,0,1), runif(n,0,1))
X <- as.matrix(cbind(1, rnorm(n)))

B <- as.matrix(c(1,5))
p <- length(B)

sigma.sq <- 2
tau.sq <- 1
phi <- 3/0.5

D <- as.matrix(dist(coords))
R <- exp(-phi*D)
```

```
w <- rmvn(1, rep(0,n), sigma.sq*R)
y <- rnorm(n, X

n.samples <- 2000

starting <- list("phi"=3/0.5, "sigma.sq"=5, "tau.sq"=1)

tuning <- list("phi"=0.1, "sigma.sq"=0.1, "tau.sq"=0.1)

priors <- list("phi.Unif"=c(3/1, 3/0.01), "sigma.sq.IG"=c(2, 1), "tau.sq.IG"=c(2, 1))

cov.model <- "exponential"

n.report <- 500
verbose <- TRUE

m.1 <- rNNGP(y~X-1, coords=coords, starting=starting, n.neighbors=10,
              tuning=tuning, priors=priors, cov.model=cov.model,
              n.samples=n.samples, n.omp.threads=2, verbose=verbose, n.report=n.report)

plot(mcmc(m.1$p.beta.samples), density=FALSE)

plot(mcmc(m.1$p.theta.samples), density=FALSE)


## End(Not run)
```

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