

# Package ‘FastGP’

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**Type** Package

**Title** Efficiently Using Gaussian Processes with Rcpp and RcppEigen

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**Description** Contains Rcpp and RcppEigen implementations of matrix operations useful for Gaussian process models, such as the inverse and determinant of a symmetric and positive-definite Toeplitz matrix, sampling from multivariate normal distributions, evaluation of the log-density of a multivariate normal vector, and Bayesian inference for latent variable Gaussian process models with elliptical slice sampling (Murray, Adams, and MacKay 2010).

**License** GPL-2

**Imports** Rcpp, MASS, mvtnorm, stats

**LinkingTo** Rcpp, RcppEigen

**Repository** CRAN

**NeedsCompilation** yes

**RoxygenNote** 7.3.1

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**Description**

The `ess` function uses elliptical slice sampling to sample from the posterior distribution within a Bayesian model in which the prior is a Gaussian process/multivariate normal. If the covariance matrix corresponding to the prior is also Toeplitz, use `ess_Toep` for a faster version.

Elliptical slice sampling is a valid Markov chain Monte Carlo algorithm for posterior sampling when the prior is a Gaussian process/multivariate normal.

Murray, I., Adams, R., & MacKay, D. (2010, March). Elliptical slice sampling. In Proceedings of the thirteenth international conference on artificial intelligence and statistics (pp. 541-548). JMLR Workshop and Conference Proceedings.

**Usage**

```
ess(log.lik,Y, Sig, N_mcmc,burn_in,N,flag)
ess_Toep(log.lik,Y, Sig, N_mcmc,burn_in,N)
```

**Arguments**

|                      |                                                                                                                                                                        |
|----------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <code>log.lik</code> | Log-lik function in model which is assumed to take two arguments: the first contains the parameters/latent variables and the second the observed data <code>Y</code> . |
| <code>Y</code>       | Observed data.                                                                                                                                                         |
| <code>Sig</code>     | Covariance matrix associated with the prior distribution on the parameters/latent variable vector.                                                                     |
| <code>N_mcmc</code>  | Number of desired mcmc samples.                                                                                                                                        |
| <code>burn_in</code> | Number of burn-in iterations.                                                                                                                                          |
| <code>N</code>       | Dimensionality of parameter/latent variable vector.                                                                                                                    |
| <code>flag</code>    | Set to TRUE for MASS implementation of <code>mvrnorm</code> , FALSE for FastGP implementation of <code>rcpp_rmvnorm</code> .                                           |

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**Examples**

```
# See demo/FastGPDemo.r.
```

**Description**

Performs useful matrix operations using Rcpp and RcppEigen, and some custom C++ to handle symmetric, positive definite, Toeplitz matrices.

**Usage**

```
rcppeigen_invert_matrix(A)
rcppeigen_get_det(A)
rcppeigen_get_chol(A)
rcppeigen_get_chol_stable(A)
rcppeigen_get_chol_diag(A)
tinv(A)
tdet(A)
```

**Arguments**

A                      Matrix to perform operation on.

**Details**

Functions with "rcppeigen" directly call RcppEigen implementations of the associated functions; `rcppeigen_get_chol_stable` retrieves L and `rcppeigen_get_chol_diag(A)` retrieves D in  $A = LDL^T$  form, whereas `rcppeigen_get_chol(A)` retrieves L in  $A = LL^T$  form. The function `tinv` computes an inverse and `tdet` returns the log-determinant of a symmetric, positive-definite, Toeplitz matrix using methods from Trench and Durbin from "Matrix Computations" by Golub and Van Loan.

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**Examples**

```
# See demo/FastGPDemo.R
```

---

`rcpp_rmvnorm`*Multivariate Normal Sampling and Log-Density Evaluation*

---

**Description**

These functions allow for the sampling of and evaluation of the log-density of a multivariate normal vector.

**Usage**

```
rcpp_log_dmvnorm(S,mu,x, istoep)
rcpp_rmvnorm(n,S,mu)
rcpp_rmvnorm_Toep(n,S,mu)
rcpp_rmvnorm_stable(n,S,mu)
```

**Arguments**

|                     |                                                        |
|---------------------|--------------------------------------------------------|
| <code>S</code>      | Covariance matrix of associated multivariate normal.   |
| <code>n</code>      | Number of (independent) samples to generate.           |
| <code>mu</code>     | Mean vector.                                           |
| <code>x</code>      | Vector of observations to evaluate the log-density of. |
| <code>istoep</code> | set this to TRUE if <code>S</code> is Toeplitz.        |

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**Examples**

```
#See demo/FastGPDemo.R
```

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