

Package ‘rsDCM’

October 6, 2026

Type Package

Title Robust and Sparse Dynamic Causal Modelling for Functional MRI

Version 0.1.0

Date 2026-09-24

Maintainer Godfred Arhin <arhin0122@gmail.com>

Description Provides a robust and sparse method for group-level Dynamic Causal Modelling (DCM) of functional magnetic resonance imaging (fMRI) data: Student-t weighting of subjects for robustness, combined with a nonlocal product-moment (pMOM) spike-and-slab prior for sparse selection of group-level effects (<[doi:10.48550/arXiv.2609.06379](https://doi.org/10.48550/arXiv.2609.06379)>). The package also provides an R implementation of single-subject DCM for fMRI using variational Laplace inversion (Friston et al., 2003 <[doi:10.1016/S1053-8119\(03\)00202-7](https://doi.org/10.1016/S1053-8119(03)00202-7)>), including the bilinear neural state equation and the Buxton-Friston hemodynamic response model, ported from the 'SPM25' (version 25.01.02) toolbox for 'MATLAB'.

License GPL-2

Encoding UTF-8

LazyData true

Depends R (>= 4.0.0)

Imports Matrix, expm, MASS, methods, stats, utils

Suggests testthat (>= 3.0.0), knitr, rmarkdown, R.matlab, withr

URL <https://github.com/Kay202/rsDCM>

BugReports <https://github.com/Kay202/rsDCM/issues>

VignetteBuilder knitr

Config/testthat/edition 3

Config/roxygen2/version 8.0.0

NeedsCompilation no

Author Godfred Arhin [aut, cre, trl],
Nilotpal Sanyal [aut],
SPM25 Authors [ctb, cph] (Original MATLAB SPM25 (v25.01.02)
implementation; see LICENSE.note)

Repository CRAN
Date/Publication 2026-10-06 07:40:02 UTC

Contents

rsDCM-package	2
dcm_estimate	4
dcm_evidence	5
dcm_fmri_priors	6
dcm_fx_fmri	7
dcm_gx_fmri	7
dcm_int	8
dcm_nlsi_GN	9
dcm_peb_of_pebs	10
dcm_peb_prepare	11
dcm_peb_run	12
narps_dcm	12
rsdcm	14
rsdcm_fit	16
rsdcm_options	17
toy_dcm	18
Index	20

rsDCM-package	<i>rsDCM: Robust and Sparse Dynamic Causal Modelling for Functional MRI</i>
---------------	---

Description

rsDCM provides a robust and sparse method for group-level Dynamic Causal Modelling (DCM) of fMRI data, together with an R implementation of single-subject DCM ported from the MATLAB SPM25 toolbox.

Details

The package’s main method is `rsdcm` (with the convenience wrapper `rsdcm_fit`): a group-level model that weights subjects by a Student-t likelihood (robustness to outliers) and selects group-level effects with a nonlocal product-moment (pMOM) spike-and-slab prior (sparsity), with ReML-estimated between-subject variance components. The “rs” is *robust and sparse*; it does not denote resting-state fMRI.

For single-subject inversion, the main entry point is `dcm_estimate`.

Group-level modelling (robust and sparse)

- `rsdcm` Robust, sparse group DCM (Student-t + pMOM).
- `rsdcm_fit` Assemble `rsdcm` inputs from a list of fitted DCMs.
- `rsdcm_options` Get or set package numerical options.

Single-subject DCM estimation (SPM25 port)

`dcm_estimate` Full DCM inversion (main entry point).
`dcm_nlsi_GN` Variational Laplace / Gauss-Newton inversion.
`dcm_int` Bilinear-system integrator (forward model).
`dcm_fmri_priors` Construct fMRI DCM priors.
`dcm_fx_fmri`, `dcm_gx_fmri` Neural-state and BOLD observation equations.
`dcm_bireduce`, `dcm_kernels` Bilinear reduction and Volterra kernels.
`dcm_evidence`, `dcm_log_evidence`, `dcm_log_evidence_reduce` Model evidence and Bayesian model reduction.

Parametric Empirical Bayes (Gaussian group modelling)

`dcm_peb_prepare`, `dcm_peb_run` Prepare and fit a second- or third-level PEB.
`dcm_peb_of_pebs` Third-level PEB-of-PEBs over a directory of subject PEBs.
`dcm_peb_design`, `dcm_peb_files`, `dcm_peb_load` Design-matrix and subject-PEB loading helpers.

Datasets

`toy_dcm` Three-region single-subject DCM specification.
`narps_dcm` 48-subject NARPS DCM summaries used by `rsdcm`.

Lower-level numerical helpers (matrix and vector utilities, numerical differentiation, matrix exponentials, and error-covariance bases) are also exported and documented; see, for example, `dcm_vec`, `dcm_inv`, `dcm_diff`, and `dcm_Ce`.

Acknowledgment

The single-subject DCM routines are a derivative work of the MATLAB SPM25 (version 25.01.02) toolbox, distributed under GPL-2 by the Wellcome Centre for Human Neuroimaging. See the `LICENSE.note` file in the package source for the list of ported routines.

Author(s)

Maintainer: Godfred Arhin <arhin0122@gmail.com> [translator]

Authors:

- Godfred Arhin <arhin0122@gmail.com> [translator]
- Nilotpal Sanyal <nsanyal@utep.edu>

Other contributors:

- SPM25 Authors (Original MATLAB SPM25 (v25.01.02) implementation; see `LICENSE.note`) [contributor, copyright holder]

References

- Arhin, G., Sanyal, N. (2026). Robust and Sparse Group Dynamic Causal Modeling via Student-t Parametric Empirical Bayes and Nonlocal Priors. arXiv:2609.06379. doi:10.48550/arXiv.2609.06379
- Botvinik-Nezer, R., Holzmeister, F., Camerer, C.F., et al. (2020). Variability in the analysis of a single neuroimaging dataset by many teams. Nature, 582(7810), 84-88. doi:10.1038/s41586020-23149
- Friston, K.J., Harrison, L., Penny, W. (2003). Dynamic causal modelling. NeuroImage, 19(4), 1273-1302. doi:10.1016/S10538119(03)002027
- Friston, K.J., Mattout, J., Trujillo-Barreto, N., Ashburner, J., Penny, W. (2007). Variational free energy and the Laplace approximation. NeuroImage, 34(1), 220-234. doi:10.1016/j.neuroimage.2006.08.035
- Valerio, D., Peres, A., Bergstrom, F., Seidel, P., Almeida, J. (2025). Neural and behavioral similarity-driven tuning curves for manipulable objects. Imaging Neuroscience, 3. doi:10.1162/imag_a_00482

See Also

Useful links:

- <https://github.com/Kay202/rsDCM>
- Report bugs at <https://github.com/Kay202/rsDCM/issues>

dcm_estimate

Estimate a Dynamic Causal Model for fMRI

Description

Inverts a fully-specified DCM using variational Laplace inversion. This is the main user-facing entry point of the package. Mirrors SPM25's dcm_estimate. Progress is reported via message() and can be silenced with suppressMessages().

Usage

```
dcm_estimate(P, save = FALSE)
```

Arguments

P	A DCM list, or a path to an .RData/.rds file containing one.
save	Logical. If TRUE and P is a file path, the estimated DCM is saved back to that path.

Value

The estimated DCM (a list) with posterior fields populated. The main fields of interest are Ep (posterior expectations, with Ep\$A, Ep\$B, Ep\$C the connectivity estimates), Cp (posterior covariance), Pp (posterior probabilities), and F (the negative free energy, used for model comparison).

Supported model variants

This release implements only the **deterministic, single-state** fMRI DCM. The two-state (options\$two_state), stochastic (options\$stochastic) and spectral / cross-spectral-density (options\$induced) variants are *not* yet implemented: switching any of them on causes dcm_estimate to stop with an informative error. These variants are planned for a future update. Non-linear DCM (a non-empty d array) is supported.

See Also

[dcm_nlsi_GN](#) for the underlying inversion, [dcm_fmri_priors](#) for the priors it constructs.

Examples

```
data(toy_dcm)
str(toy_dcm, max.level = 1)

# Full inversion of the bundled three-region model (takes about a minute).
# Progress reporting goes through message(), so it can be silenced.
fit <- suppressMessages(dcm_estimate(toy_dcm))
round(fit$Ep$A, 3) # posterior connectivity estimates
round(fit$Pp$A, 3) # posterior probability each connection is non-zero
fit$F             # negative free energy, for model comparison
```

dcm_evidence	<i>Approximate model evidence (AIC, BIC)</i>
--------------	--

Description

AIC and BIC penalties for an estimated DCM, plus per-region cost terms. Mirrors SPM25's spm_dcm_evidence.

Usage

```
dcm_evidence(DCM)
```

Arguments

DCM An estimated DCM.

Value

List with per-region cost, AIC penalty, BIC penalty, and overall AIC and BIC.

dcm_fmri_priors	<i>Construct fMRI DCM priors</i>
-----------------	----------------------------------

Description

Builds the prior expectations pE and prior covariance pC for a deterministic fMRI DCM. Mirrors SPM25's dcm_fmri_priors.

Usage

```
dcm_fmri_priors(A, B, C, D, options = list())
```

Arguments

A	Connectivity adjacency matrix.
B	Modulatory adjacency array.
C	Driving-input adjacency matrix.
D	Non-linear adjacency array.
options	List of model options (stochastic, induced, two_state, backwards, precision, decay).

Value

List with pE (prior expectation), x (initial state template), and pC (prior covariance).

Model variants

Only the deterministic, single-state model is supported end-to-end in this release. Branches for the two-state (options\$two_state) and spectral (options\$induced) variants exist but are experimental and are not wired through [dcm_estimate](#), which rejects them. They are planned for a future update.

See Also

[dcm_estimate](#), which builds these priors for you.

Examples

```
# Priors for the bundled three-region (deterministic) model
data(toy_dcm)
pr <- dcm_fmri_priors(toy_dcm$a, toy_dcm$b, toy_dcm$c,
                     D = NULL, options = toy_dcm$options)

names(pr)
pr$pE$a      # prior expectation of the endogenous connections
dim(pr$x)    # 3 regions x 5 hemodynamic states
```

dcm_fx_fmri	<i>fMRI neural and hemodynamic state equation</i>
-------------	---

Description

Computes dx/dt for the bilinear neural state equation coupled to the Buxton-Friston hemodynamic model. Mirrors SPM25's `spm_fx_fmri`.

Usage

```
dcm_fx_fmri(x, u, P, M)
```

Arguments

x	State matrix (rows = regions, cols = state variables).
u	Driving inputs at the current time.
P	List of model parameters (A, B, C, D, transit, decay, epsilon, ...).
M	Model structure list (optional).

Value

Matrix dx/dt of the same shape as x.

dcm_gx_fmri	<i>fMRI BOLD observation equation</i>
-------------	---------------------------------------

Description

Computes the BOLD signal from the hemodynamic state variables. Mirrors SPM25's `spm_gx_fmri`.

Usage

```
dcm_gx_fmri(x, u, P, M)
```

Arguments

x	State matrix (rows = regions, cols = state variables).
u	Driving inputs at the current time.
P	List of model parameters (A, B, C, D, transit, decay, epsilon, ...).
M	Model structure list (optional).

Value

List with the BOLD prediction g and Jacobian dgdx.

dcm_int

*Integrate a bilinear DCM***Description**

Forward-integrates the model defined by M\$f (state equation) and M\$g (observation equation) under the input U, returning the predicted observations at the requested sample points.

Usage

```
dcm_int(P, M, U)
```

Arguments

P	Parameter structure.
M	Model list. Required fields: f, x; optional g, ns, delays, l.
U	List with input matrix u and time step dt.

Details

M\$f and M\$g may be given as functions or as the names of functions. M\$n must be the length of the flattened state (`length(dcm_vec(M$x))`), i.e. regions x hidden states), while M\$l is the number of observed outputs (regions) and M\$m the number of inputs.

Value

Numeric matrix of predicted observations (rows = samples).

See Also

[dcm_estimate](#), which calls this as its forward model.

Examples

```
# Simulate the BOLD response of a two-region model to a boxcar input.
n <- 2L
pri <- dcm_fmri_priors(A = matrix(1, n, n),
                     B = array(0, c(n, n, 1)),
                     C = matrix(c(1, 0), n, 1),
                     D = array(0, c(n, n, 0)),
                     options = list())

U <- list(u = matrix(c(rep(1, 16), rep(0, 16)), ncol = 1), dt = 1)
M <- list(f = "dcm_fx_fmri", g = "dcm_gx_fmri", x = pri$x,
         m = ncol(U$u), n = length(pri$x), l = nrow(pri$x), ns = 32)

# The priors put C at zero, so start from them and switch on a driving
# input to region 1 and a connection from region 1 to region 2.
```

```

P <- pri$pE
P$C[1, 1] <- 1
P$A[2, 1] <- 0.4

y <- dcm_int(P, M, U)
dim(y)           # 32 samples x 2 regions
round(y[seq(1, 32, 4), ], 3)

```

dcm_nlsi_GN

*Variational Laplace inversion of a non-linear system***Description**

Performs Gauss-Newton optimisation of the variational free energy for a non-linear forward model with Gaussian priors. Mirrors SPM25's `dcm_nlsi_GN`.

Usage

```
dcm_nlsi_GN(M, U, Y)
```

Arguments

M	Model specification (list with IS/f/g, priors pE, pC, hyperpriors hE, hC, ...).
U	Input structure passed through to M\$IS.
Y	Data (or list with \$y, \$Q, \$X0, \$dt).

Details

Most users should call `dcm_estimate` instead, which assembles M, U and Y from a DCM specification and calls this function. Use `dcm_nlsi_GN` directly only to invert a non-linear model that is not an fMRI DCM.

Progress is reported per Gauss-Newton iteration as EM: (+) k F: ..., where (+) marks an accepted step and (-) a rejected one. Set `M$noprint <- 1` to silence it.

Value

List with posterior expectation Ep, covariance Cp, log-precision estimate Eh, free energy F, and components.

See Also

`dcm_estimate` for the user-facing entry point.

Examples

```

# dcm_nlsi_GN is the Gauss-Newton optimiser that dcm_estimate() calls after
# assembling M, U and Y from a DCM specification. For a runnable inversion
# see the example in ?dcm_estimate; dcm_nlsi_GN returns the same posterior
# fields (Ep, Cp, Eh, F).

```

dcm_peg_of_pebs

*Run a third-level PEB-of-PEBs over a directory of subject PEBs***Description**

Loads subject PEBs (.rds or .mat), builds the third-level design, runs the PEB-of-PEBs, and returns a tidy summary. Optionally saves the group PEB.

Usage

```
dcm_peg_of_pebs(
  peg_dir,
  subjects = NULL,
  covariates = NULL,
  Xnames = NULL,
  save_path = NULL,
  M = list(Q = "single", alpha = 1, beta = 16, maxit = 64),
  field = "all",
  verbose = TRUE
)
```

Arguments

peg_dir	Directory containing the subject PEB files.
subjects	Optional integer vector; restrict to these subject numbers.
covariates	Optional data frame of between-subject covariates, one row per subject in the order returned by dcm_peg_files . NULL gives an intercept-only design (the group mean).
Xnames	Optional custom design column names.
save_path	Optional path to save the group PEB to, as .rds. NULL (the default) does not write anything to disk.
M	Third-level model options passed to dcm_peg_prepare .
field	Parameter blocks to model; "all" is typical for PEB inputs.
verbose	Logical. Report progress via message().

Details

Nothing is written to disk unless save_path is supplied.

Value

List with group_PEB, save_path (NULL if not saved), subjects, X (the design), and summary (a tidy data frame of parameter estimates).

See Also

[dcm_peg_prepare](#), [dcm_peg_run](#).

dcm_peb_prepare	<i>Prepare a PEB (second- or third-level) model</i>
-----------------	---

Description

Gathers the first-level posterior densities, selects the parameter indices implied by `field`, projects them onto a rank-reduced subspace, and builds the second-level priors, hyperpriors and precision components. Mirrors the preparation half of SPM25's `spm_dcm_peb`.

Usage

```
dcm_peb_prepare(P, M = list(), field = c("A", "B"))
```

Arguments

<code>P</code>	List of estimated DCMs (or, for a PEB-of-PEBs, a list of PEBs). Each element must carry <code>M\$pE</code> , <code>M\$pC</code> , <code>Ep</code> , <code>Cp</code> and <code>F</code> .
<code>M</code>	Second-level model specification. Recognised fields: <code>X</code> (design matrix, subjects x covariates), <code>W</code> , <code>Q</code> (covariance component option, see Details), <code>bE</code> , <code>bC</code> , <code>pC</code> , <code>hE</code> , <code>hC</code> , <code>alpha</code> , <code>beta</code> , <code>Xnames</code> , <code>maxit</code> . Defaults to an intercept-only design.
<code>field</code>	Character vector of parameter blocks to model (e.g. <code>c("A", "B")</code>), the string <code>"all"</code> for every named block, or numeric indices into <code>dcm_vec(M\$pE)</code> .

Details

`M$Q` selects the form of the second-level precision components: `"single"` (one component, the default), `"fields"` (one per requested field), `"all"` (one per parameter), `"none"` (no components), or a list of numeric matrices for manual specification.

Value

A list ("prep") consumed by [dcm_peb_run](#), holding the projected densities, design, priors, precision components and sizes.

See Also

[dcm_peb_run](#) to fit the prepared model.

dcm_peb_run

Fit a prepared PEB model by variational Laplace

Description

Runs the variational Laplace (Fisher scoring) loop on the structure built by [dcm_peb_prepare](#), and returns the group-level PEB together with the first-level DCMs updated under the empirical priors. Mirrors the estimation half of SPM25's `spm_dcm_peb`.

Usage

```
dcm_peb_run(prepare, verbose = TRUE)
```

Arguments

<code>prepare</code>	The list returned by dcm_peb_prepare .
<code>verbose</code>	Logical. Report free energy per iteration via <code>message()</code> . Silence with <code>suppressMessages()</code> or <code>verbose = FALSE</code> .

Details

Progress is reported as VL Iter k: F=... dF=... [t=...], where t is the log step size of the Fisher scoring update. The loop stops when the step size collapses or the free-energy increase falls below 1e-4.

Value

List with two elements: PEB, the group-level result (Ep group parameter expectations, Cp their covariance, Eh/Ch log-precision estimates, F free energy, and the Pnames/Xnames/Snames labels), and P, the input DCMs with Ep, Cp, MspE, MspC and F updated under the empirical priors.

See Also

[dcm_peb_prepare](#), [dcm_peb_of_pebs](#).

narps_dcm

Subject-level DCM summaries for a group analysis (NARPS)

Description

Subject-level DCM posterior summaries for 48 subjects, used to demonstrate the robust and sparse group-level model [rsdcm](#). The summaries are the inputs a group analysis needs: a posterior mean and covariance per subject.

Usage

```
narps_dcm
```

Format

A list with:

eta 48 x 22 matrix of subject-level posterior means (subjects in rows, parameters in columns).

Cp Length-48 list of 22 x 22 posterior covariance matrices.

parameter_names Length-22 character vector, e.g. "A(1,1)", "B(2,1,1)".

subject Length-48 character vector of de-identified subject ids.

covariates Data frame of between-subject covariates: group, gender, age.

regions The four region labels, in order.

Details

Each subject has 22 parameters: the 16 intrinsic connections of a four-region DCM (A) plus 6 task-modulatory connections (B), across the regions vmPFC, vStr (ventral striatum), amygdala, and anterior insula.

Source

Subject-level Dynamic Causal Modelling summaries computed by the package author from the openly shared NARPS dataset: Botvinik-Nezer, R., Holzmeister, F., Camerer, C. F., et al. (2020), "Variability in the analysis of a single neuroimaging dataset by many teams", *Nature*, 582(7810), 84-88, doi:[10.1038/s4158602023149](https://doi.org/10.1038/s4158602023149). The build script that prepared the shipped object is in `data-raw/make-narps-dcm.R`.

See Also

[rsdcm](#), which this dataset is the example input for.

Examples

```
data(narps_dcm)
dim(narps_dcm$eta)           # 48 subjects x 22 parameters
length(narps_dcm$Cp)         # one posterior covariance per subject
table(narps_dcm$covariates$group)
```

rsdcm

*Robust and sparse group-level DCM (Student-t + pMOM)***Description**

Fits a group-level model to subject-level DCM parameter estimates that is robust to outlier subjects and performs Bayesian variable selection on the group effects. The model combines three ingredients: Student-t weighting of subjects (robustness), a nonlocal product-moment (pMOM) spike-and-slab prior on the group effects (sparsity / inclusion probabilities), and ReML-estimated between-subject variance components. Estimation is by EM.

Usage

```
rsdcm(
  eta_theta_y,
  C_theta_y_list,
  X_G,
  V_list,
  nu = 3,
  tau0 = 0.05,
  tau1 = 1,
  pi = 0.5,
  a0 = 2,
  b0 = 0.01,
  a1 = 2,
  b1 = 1,
  min_slab_spike_ratio = 1,
  max_iter = 500,
  tol = 1e-06,
  inner_sweeps = 3,
  verbose = TRUE,
  max_beta_step = 1,
  min_alpha = 1e-08,
  max_alpha = 100
)
```

Arguments

eta_theta_y	N x p matrix of subject-level posterior means (subjects in rows, parameters in columns).
C_theta_y_list	Length-N list of p x p subject-level posterior covariance matrices.
X_G	N x r group (between-subject) design matrix.
V_list	List of p x p basis matrices for the between-subject covariance $\Sigma_b = \sum_k \alpha_k V_k$. A per-parameter diagonal basis is a common default.
nu	Student-t degrees of freedom (smaller = heavier-tailed, more robust).

<code>tau0, tau1</code>	Initial spike and slab standard deviations.
<code>pi</code>	Prior inclusion probability (slab weight).
<code>a0, b0, a1, b1</code>	Inverse-Gamma hyperprior parameters on τ_0^2 and τ_1^2 .
<code>min_slab_spike_ratio</code>	Identifiability guard: enforce $\tau_1 \geq \text{min_slab_spike_ratio} * \tau_0$.
<code>max_iter</code>	Maximum EM iterations.
<code>tol</code>	Convergence tolerance on the change in beta and alpha.
<code>inner_sweeps</code>	Coordinate-Newton sweeps per M-step for beta.
<code>verbose</code>	Logical. Report progress via <code>message()</code> ; silence with <code>suppressMessages()</code> or <code>verbose = FALSE</code> .
<code>max_beta_step</code>	Per-coordinate cap on the beta Newton step.
<code>min_alpha, max_alpha</code>	Bounds on the variance components.

Details

This is an alternative to the Gaussian Parametric Empirical Bayes layer ([dcm_peb_run](#)); the numerics are original to the package, not a port of SPM. Most users will call the convenience wrapper [rsdcm_fit](#), which assembles the arguments below from a list of fitted DCMs.

Value

A list with the group-level effects `beta_mat` ($p \times r$) and `beta_vec`, posterior inclusion probabilities `inclusion` ($p \times r$), Student-t weights, variance components `alpha`, learned scales `tau0/tau1`, residual variance `sigma2`, fitted means `mu_hat` ($N \times p$), and the sizes `N`, `p`, `r`.

References

Arhin, G., Sanyal, N. (2026). Robust and sparse group dynamic causal modeling via Student-t parametric empirical Bayes and nonlocal priors. arXiv:2609.06379. doi:10.48550/arXiv.2609.06379

See Also

[rsdcm_fit](#) for the wrapper over fitted DCMs, [dcm_peb_run](#) for the Gaussian PEB alternative, [narps_dcm](#) for the example dataset.

Examples

```
# Real 48-subject NARPS group analysis. The inputs are precomputed
# subject-level DCM summaries (a posterior mean and covariance per subject).
data(narps_dcm)
N <- nrow(narps_dcm$eta)
p <- ncol(narps_dcm$eta)
# Per-parameter variance-component basis, and an intercept-only design.
V_list <- lapply(seq_len(p), function(k) { V <- matrix(0, p, p); V[k, k] <- 1; V })
X_G <- matrix(1, N, 1, dimnames = list(NULL, "intercept"))
```

```

fit <- rsdcm(narps_dcm$eta, narps_dcm$Cp, X_G, V_list, verbose = FALSE)
rownames(fit$beta_mat) <- rownames(fit$inclusion) <- narps_dcm$parameter_names

# Group-level connections selected by the spike-and-slab prior (PIP > 0.5)
sel <- fit$inclusion[, 1] > 0.5
round(cbind(estimate = fit$beta_mat[sel, 1],
            PIP       = fit$inclusion[sel, 1]), 3)

# Subjects the Student-t weighting down-weights most
w <- rowMeans(matrix(fit$weights, N, p, byrow = TRUE))
narps_dcm$subject[order(w)][1:5]

```

rsdcm_fit

Robust sparse group DCM from a list of fitted DCMs

Description

Convenience wrapper around [rsdcm](#) that assembles its inputs from a list of estimated DCMs (as returned by [dcm_estimate](#)). For each subject it takes the posterior mean E_p and covariance C_p restricted to the requested parameter field, builds a between-subject design, and fits the robust + sparse group model.

Usage

```
rsdcm_fit(P, field = "A", covariates = NULL, X_G = NULL, V_list = NULL, ...)
```

Arguments

P	List of estimated DCMs; each must carry E_p , C_p , and M_{pE}/M_{pC} (or options) so the field indices can be resolved.
field	Parameter block(s) to model at the group level, named as in the DCM parameter structure E_p . For an fMRI DCM these are "A", "B", "C", "D", "transit", "decay" and "epsilon"; pass one (e.g. "A") or several (e.g. c("A", "B")). Case-sensitive: the connectivity blocks are uppercase ("A", not "a"). Passed to dcm_find_pC .
covariates	Optional data frame of between-subject covariates, one row per subject; NULL gives an intercept-only design (the group mean). Ignored if X_G is supplied.
X_G	Optional group design matrix (N x r); overrides covariates.
V_list	Optional list of p x p variance-component bases; defaults to a per-parameter diagonal basis.
...	Further arguments passed to rsdcm (e.g. nu, pi, verbose).

Details

All subjects must share the same parameterisation, so the selected field indices are required to match across P.

Value

The list returned by `rsdcm`, with the group effects and inclusion probabilities labelled by the selected parameters and design columns, plus the selected `param_index`.

See Also

`rsdcm`, `dcm_estimate`, `dcm_peb_design`.

Examples

```
# rsdcm_fit() consumes a list of fitted DCMs (each from dcm_estimate), then
# fits the group model on a chosen field:
# fits <- lapply(dcm_files, function(f) dcm_estimate(readRDS(f)))
# grp <- rsdcm_fit(fits, field = "A", covariates = my_covariates)
# For a runnable group-level example on precomputed subject summaries, see
# ?rsdcm and the narps_dcm dataset.
```

rsdcm_options

Get or set rsDCM runtime options

Description

Read or modify package-internal numerical options. Currently the only option is `GLOBAL_DX`, the finite-difference step used by `dcm_diff` when computing numerical Jacobians.

Usage

```
rsdcm_options(...)
```

Arguments

... Named arguments to set. Call with no arguments to retrieve the current option list.

Value

The current option list (invisibly when setting).

Examples

```
rsdcm_options()                      # show current options
rsdcm_options(GLOBAL_DX = 1e-4) # widen the FD step
rsdcm_options(GLOBAL_DX = exp(-8)) # restore default
```

toy_dcm

*Example DCM for fMRI inversion***Description**

A three-region Dynamic Causal Model used in the documentation, vignette, and tests. It is an input specification (no posterior fields), ready to invert with `dcm_estimate`.

Usage

toy_dcm

Format

A list with the standard SPM-style DCM fields:

a 3 x 3 binary matrix of endogenous connections to estimate.

b 3 x 3 x 1 binary array of modulatory connections.

c 3 x 1 binary matrix of driving inputs; here the input enters region 3 only.

Y Observed BOLD data. **Y\$y** is the 482 x 3 time-series matrix (rows = scans, columns = regions); **Y\$dt** is the sampling interval in seconds; **Y\$X0** is the confound design; **Y\$Q** is the error-covariance component list; **Y\$name** holds the region names.

U Input design. **U\$u** is the 482 x 1 input matrix at the microtime resolution; **U\$dt** is the microtime step; **U\$name** holds the input names.

n, v Number of regions (3) and number of scans (482).

TE Echo time in seconds.

name Name of the model.

xY Region (VOI) structure carried over from the source DCM.

options Estimation options: `nonlinear`, `two_state`, `stochastic`, `centre`, `mode`, `maxit`, `induced`, `maxnodes`, `hE`, `hC`.

Details

The model has 3 regions and 482 scans, with a single driving input entering region 3 and a single modulatory input. All entries of the **a** matrix are enabled, so every directed connection between the three regions is estimated.

Source

Derived from the fMRI data of Valerio et al. (2025), "Neural and behavioral similarity-driven tuning curves for manipulable objects", *Imaging Neuroscience*, 3, doi:10.1162/imag_a_00482, via a Dynamic Causal Modelling exercise carried out with that data during package development. The build script that prepared the shipped object is in `data-raw/make-toy-dcm.R`. See the package CITATION for the full author list.

Examples

```
data(toy_dcm)
str(toy_dcm, max.level = 1)
# Invert it with dcm_estimate(toy_dcm); see ?dcm_estimate for a runnable
# (donttest) inversion example.
```

Index

* datasets

- narps_dcm, [12](#)
- toy_dcm, [18](#)

- dcm_bireduce, [3](#)
- dcm_Ce, [3](#)
- dcm_diff, [3](#), [17](#)
- dcm_estimate, [2](#), [3](#), [4](#), [6](#), [8](#), [9](#), [16–18](#)
- dcm_evidence, [3](#), [5](#)
- dcm_find_pC, [16](#)
- dcm_fmri_priors, [3](#), [5](#), [6](#)
- dcm_fx_fmri, [3](#), [7](#)
- dcm_gx_fmri, [3](#), [7](#)
- dcm_int, [3](#), [8](#)
- dcm_inv, [3](#)
- dcm_kernels, [3](#)
- dcm_log_evidence, [3](#)
- dcm_log_evidence_reduce, [3](#)
- dcm_nlsi_GN, [3](#), [5](#), [9](#)
- dcm_peb_design, [3](#), [17](#)
- dcm_peb_files, [3](#), [10](#)
- dcm_peb_load, [3](#)
- dcm_peb_of_pebs, [3](#), [10](#), [12](#)
- dcm_peb_prepare, [3](#), [10](#), [11](#), [12](#)
- dcm_peb_run, [3](#), [10](#), [11](#), [12](#), [15](#)
- dcm_vec, [3](#)

- narps_dcm, [3](#), [12](#), [15](#)

- rsDCM (rsDCM-package), [2](#)
- rsdcm, [2](#), [12](#), [13](#), [14](#), [16](#), [17](#)
- rsDCM-package, [2](#)
- rsdcm_fit, [2](#), [15](#), [16](#)
- rsdcm_options, [2](#), [17](#)

- toy_dcm, [3](#), [18](#)