Package ‘ROptSpace’

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Type Package

Title Matrix Reconstruction from a Few Entries

Version 0.2.3

Description Matrix reconstruction, also known as matrix completion, is the task of inferring missing entries of a partially observed matrix. This package provides a method called OptSpace, which was proposed by Keshavan, R.H., Oh, S., and Montanari, A. (2009) <doi:10.1109/ISIT.2009.5205567> for a case under low-rank assumption.

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LinkingTo Rcpp, RcppArmadillo

RdMacros Rdpack

RoxygenNote 7.1.1

NeedsCompilation yes

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Contents

OptSpace *OptSpace : an algorithm for matrix reconstruction from a partially revealed set*

Description

Let's assume an ideal matrix M with $(m \times n)$ entries with rank r and we are given a partially observed matrix M_E which contains many missing entries. Matrix reconstruction - or completion - is the task of filling in such entries. OptSpace is an efficient algorithm that reconstructs M from $|E| = O(rn)$ observed elements with relative root mean square error (RMSE)

$$RMSE \le C(\alpha)\sqrt{nr/|E|}$$

Usage

```
OptSpace(A, ropt = NA, niter = 50, tol = 1e-06, showprogress = TRUE)
```

Arguments

`A`	an $(n \times m)$ matrix whose missing entries should be flaged as NA.
`ropt`	`NA` to guess the rank, or a positive integer as a pre-defined rank.
`niter`	maximum number of iterations allowed.
`tol`	stopping criterion for reconstruction in Frobenius norm.
`showprogress`	a logical value; `TRUE` to show progress, `FALSE` otherwise.

Value

a named list containing

X an $(n \times r)$ matrix as left singular vectors.

S an $(r \times r)$ matrix as singular values.

Y an $(m \times r)$ matrix as right singular vectors.

dist a vector containing reconstruction errors at each successive iteration.

References

Keshavan RH, Montanari A, Oh S (2010). "Matrix Completion From a Few Entries." *IEEE Transactions on Information Theory*, **56**(6), 2980–2998. ISSN 0018-9448.

Examples

```
## Parameter Settings
n = 1000;
m = 100;
r = 3;
tolerance = 1e-7
```

```
eps = 10*r*log10(n)

## Generate a matrix with given data
U = matrix(rnorm(n*r),nrow=n)
V = matrix(rnorm(m*r),nrow=m)
Sig = diag(r)
M0 = U%*%Sig%*%t(V)

## Set some entries to be NA with probability eps/sqrt(m*n)
E = 1 - ceiling(matrix(rnorm(n*m),nrow=n) - eps/sqrt(m*n))
M_E = M0
M_E[(E==0)] = NA

## Create a noisy version
noiselevel = 0.1
M_E_noise  = M_E + matrix(rnorm(n*m),nrow=n)*noiselevel

## Use OptSpace for reconstruction
res1 = OptSpace(M_E,tol=tolerance)
res2 = OptSpace(M_E_noise,tol=tolerance)

## Compute errors for both cases using Frobenius norm
err_clean = norm(res1$X%*%res1$S%*%t(res1$Y)-M0,'f')/sqrt(m*n)
err_noise = norm(res2$X%*%res2$S%*%t(res2$Y)-M0,'f')/sqrt(m*n)

## print out the results
m1 = sprintf('RMSE without noise         : %e',err_clean)
m2 = sprintf('RMSE with noise of %.2f    : %e',noiselevel,err_noise)
print(m1)
print(m2)
```

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