

README: Software for ‘Convex Denoising using Non-Convex Tight Frame Regularization’

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1 Introduction

This is a readme file for the MATLAB code included with the paper ‘Convex Denoising using Non-Convex Tight Frame Regularization’. Jump to Section 3 for examples.

2 Description of Core Functions

2.1 bp_ncvx.m

Signal denoising using non-convex tight frame regularization.

2.1.1 Usage

```
[x,cost,err] = bp_ncvx(y,A,AH,lam,a,mu,Nit,pen)
```

The matrices A,AH are function handles.

2.1.2 Inputs

- y - Input signal
- A - Tight-frame, i.e., $A^H * A = rI$, $r > 0$
- AH - Conjugate transpose of A
- lam - Regularization parameter
- a - degree of non-convexity. Note: $a < 1/(r*lam)$
- mu - Augmented Lagrangian parameter for ADMM ($mu > 1/r$)
- Nit - Number of Iterations
- pen - Regularizer to be used
 - a. Logarithmic ('log')
 - b. Rational ('rat')
 - c. Arctangent ('atan')
 - d. L1 norm ('l1')

2.1.3 Outputs

- x - Denoised signal
- cost - Cost function history
- err - Error when using variable splitting, i.e., $||u-Ax||_2^2$

2.2 bp_ncvx2DCWT.m

Convex denoising of 2D image using non-convex tight frame regularization with the 2D dual tree complex wavelet transform.

2.2.1 Usage

```
x = bp_ncvx2DCWT(y,A,AH,J,lam,a,mu,Nit,pen)
```

2.2.2 Inputs

- y - Input image
- A - Forward transform (Undecimated Wavelet transform)
- AH - Inverse transform
- J - Number of scales
- lam - Regularization parameter (vector)

a - Degree of non-convexity ($a < 1/(r \cdot \text{lam})$)
 mu - Augmented Lagrangian parameter ($\mu > 1/r$)
 Nit - Number of iterations
 pen - Regularizer to be used

- a. Logarithmic ('log')
- b. Rational ('rat')
- c. Arctangent ('atan')
- d. L1 ('l1')

2.2.3 Outputs

x - denoised image

2.3 bp_ncvxUDWT.m

1D signal denoising using non-convex regularization with the undecimated wavelet transform

2.3.1 Usage

`[x,cost] = bp_ncvxUDWT(y,A,AH,J,lam,a,mu,Nit,pen)`

2.3.2 Inputs

y - Input Signal
 A - Forward transform (Undecimated Wavelet transform)
 AH - Inverse transform
 J - Number of scales
 lam - Regularization parameter (vector)
 a - Degree of non-convexity ($a_i < 1/\text{lam}_i$)
 mu - Augmented Lagrangian parameter ($\mu > 1/r$)
 Nit - Number of iterations
 pen - Regularizer to be used

- a. Logarithmic ('log')
- b. Rational ('rat')
- c. Arctangent ('atan')
- d. L1 ('l1')

2.3.3 Outputs

x - Denoised Signal
 cost - Cost function history

3 Matlab Demo

3.1 1D signal denoising

Need to have ADOBE Reader installed. Else open the file 'demo1D.pdf' manually.

[1D signal denoising MATLAB demo](#)

3.2 2D image denoising

Need to have ADOBE Reader installed. Else open the file 'demo2D.pdf' manually.

[2D Image denoising MATLAB demo](#)