

---

# **FNFTpy Documentation**

***Release 0.3.0***

**Christoph Mahnke**

**Mar 07, 2020**



## CONTENTS:

<b>1</b>	<b>Module overview</b>	<b>1</b>
<b>2</b>	<b>Auxiliary functions</b>	<b>3</b>
2.1	set destination of FNFT library . . . . .	3
2.2	get and print FNFT version . . . . .	3
<b>3</b>	<b>Korteweg-de-Fries equation</b>	<b>5</b>
3.1	kdvv - calculate the Nonlinear Fourier Transform . . . . .	5
3.2	kdvv_wrapper - interact with FNFT library . . . . .	6
3.3	get, set and print options for kdvv_wrapper . . . . .	6
3.4	options KdvvOptionsStruct . . . . .	7
<b>4</b>	<b>Nonlinear Schroedinger equation with periodic boundaries</b>	<b>9</b>
4.1	nsep - calculate the Nonlinear Fourier Transform . . . . .	9
4.2	nsep_wrapper - interact with FNFT library . . . . .	11
4.3	get, set and print options for nsep wrapper . . . . .	11
4.4	options NsepOptionsStruct . . . . .	13
<b>5</b>	<b>Nonlinear Schroedinger equation with vanishing boundaries</b>	<b>15</b>
5.1	nsev - calculate the Nonlinear Fourier Transform . . . . .	15
5.2	nsev_wrapper - interact with FNFT library . . . . .	17
5.3	get, set and print options for nsep wrapper . . . . .	18
5.4	options NsevOptionsStruct . . . . .	19
<b>6</b>	<b>Nonlinear Schroedinger equation with vanishing boundaries - Inverse Nonlinear Fourier Transform</b>	<b>21</b>
6.1	nsev_inverse_xi_wrapper . . . . .	21
6.2	nsev_inverse - calculate the Inverse Nonlinear Fourier Transform . . . . .	22
6.3	nsev_inverse_wrapper - interact with FNFT library . . . . .	23
6.4	get, set and print options for nsev_inverse_wrapper . . . . .	24
6.5	options NsevInverseOptionsStruct . . . . .	25
	<b>Python Module Index</b>	<b>27</b>
	<b>Index</b>	<b>29</b>



## MODULE OVERVIEW

This file is part of FNFTpy. FNFTpy provides wrapper functions to interact with FNFT, a library for the numerical computation of nonlinear Fourier transforms.

For FNFTpy to work, a copy of FNFT has to be installed. For general information, source files and installation of FNFT, visit FNFT's github page: <https://github.com/FastNFT>

For information about setup and usage of FNFTpy see README.md or documentation.

FNFTpy is free software; you can redistribute it and/or modify it under the terms of the version 2 of the GNU General Public License as published by the Free Software Foundation.

FNFTpy is distributed in the hope that it will be useful, but WITHOUT ANY WARRANTY; without even the implied warranty of MERCHANTABILITY or FITNESS FOR A PARTICULAR PURPOSE. See the GNU General Public License for more details.

You should have received a copy of the GNU General Public License along with this program. If not, see <http://www.gnu.org/licenses/>.

Contributors:

Christoph Mahnke, 2018, 2019



## AUXILIARY FUNCTIONS

### 2.1 set destination of FNFT library

`FNFTpy.get_lib_path()`

Return the path of the FNFT file.

Edit this function to set the location of the compiled library for FNFT. See example strings below.

Returns:

- `libstring` : string holding library path

Example paths:

- `libstr = "C:/Libraries/local/libfnft.dll"` # example for windows
- `libstr = "/usr/local/lib/libfnft.so"` # example for linux

### 2.2 get and print FNFT version

`FNFTpy.get_fnft_version()`

Get the version of FNFT used by calling `fnft_version`.

Returns:

- **rdict: dictionary holding the fields:**
  - `return_value` : return value from FNFT
  - `major` : major version number
  - `minor` : minor version number
  - `patch` : patch level
  - `suffix` : suffix string

`FNFTpy.print_fnft_version()`

Prints the path and the version of FNFT library used.





## KORTEWEG-DE-FRIES EQUATION

### 3.1 kdvv - calculate the Nonlinear Fourier Transform

`FNFTpy.fnft_kdvv_wrapper.kdvv(u, tvec, M=128, Xi1=-2, Xi2=2, dis=None)`

Calculate the Nonlinear Fourier Transform for the Korteweg-de Vries equation with vanishing boundaries.

This function is intended to be 'convenient', which means it automatically calculates some variables needed to call the C-library and uses some default options. Own options can be set by passing optional arguments (see below).

Currently, only the continuous spectrum is calculated.

It converts all Python input into the C equivalent and returns the result from FNFT. If a more C-like interface is desired, the function 'kdvv\_wrapper' can be used (see documentation there).

Arguments:

- `u` : numpy array holding the samples of the field to be analyzed
- `tvec` : time vector
- `M` : number of samples for the continuous spectrum to calculate,

Optional arguments:

- `Xi1, Xi2` : min and max frequency for the continuous spectrum, default = [-2,2]
- `dis` : determines the discretization, default = 17
  - 0 = 2split1a
  - 1 = 2split1b
  - 2 = 2split2a
  - 3 = 2split2b
  - 4 = 2split2s
  - 5 = 2split3a
  - 6 = 2split3b
  - 7 = 2split3s
  - 8 = 2split4a
  - 9 = 2split4b
  - 10 = 2split5a
  - 11 = 2split5b
  - 12 = 2split6a
  - 13 = 2split6b
  - 14 = 2split7a

- 15 = 2split7b
- 16 = 2split8a
- 17 = 2split8b

Returns:

- rdict : dictionary holding the fields:
  - return\_value : return value from FNFT
  - cont : continuous spectrum
  - options : KdvvOptionsStruct with options used

## 3.2 kdvv\_wrapper - interact with FNFT library

`FNFTpy.fnft_kdvv_wrapper.kdvv_wrapper(D, u, T1, T2, M, Xi1, Xi2, K, options)`

Calculate the Nonlinear Fourier Transform for the Korteweg-de Vries equation with vanishing boundaries.

This function's interface mimics the behavior of the function 'fnft\_kdvv' of FNFT. It converts all Python input into the C equivalent and returns the result from FNFT. If a more simplified version is desired, 'kdvv' can be used (see documentation there).

Currently, only the continuous spectrum is calculated.

Arguments:

- D : number of samples
- u : numpy array holding the samples of the field to be analyzed
- T1, T2 : time positions of the first and the last sample
- M : number of values for the continuous spectrum to calculate
- Xi1, Xi2 : min and max frequency for the continuous spectrum
- K : maximum number of bound states to calculate (no effect yet)
- options : options for kdvv as KdvvOptionsStruct. Can be generated e.g. with 'get\_kdvv\_options()'

Returns:

- rdict : dictionary holding the fields:
  - return\_value : return value from FNFT
  - cont : continuous spectrum
  - options : KdvvOptionsStruct with options used

## 3.3 get, set and print options for kdvv\_wrapper

`FNFTpy.options_handling.fnft_kdvv_default_options_wrapper()`

Get the default options for kdvv directly from the FNFT C-library.

Returns:

- options : KdvvOptionsStruct with options for kdvv\_wrapper

`FNFTpy.options_handling.get_kdvv_options(dis=None)`

Get an KdvvOptionsStruct struct for use with kdvv\_wrapper.

When called without additional optional arguments, the default values from FNFT are used.

Optional arguments:

- dis: discretization, default = 17
  - 0 = 2split1a
  - 1 = 2split1b
  - 2 = 2split2a
  - 3 = 2split2b
  - 4 = 2split2s
  - 5 = 2split3a
  - 6 = 2split3b
  - 7 = 2split3s
  - 8 = 2split4a
  - 9 = 2split4b
  - 10 = 2split5a
  - 11 = 2split5b
  - 12 = 2split6a
  - 13 = 2split6b
  - 14 = 2split7a
  - 15 = 2split7b
  - 16 = 2split8a
  - 17 = 2split8b

Returns:

- options : KdvvOptionsStruct

`FNFTpy.options_handling.print_kdvv_options (options=None)`

Print options of a KdvvOptionsStruct.

When called without additional argument, the default options from FNFT are printed.

Optional arguments:

- options : KdvvOptionsStruct, e.g. created by `get_kdvv_options()`

## 3.4 options KdvvOptionsStruct

```
class FNFTpy.typesdef.KdvvOptionsStruct
```

Ctypes options struct for interfacing `fnft_kdvv`.

Fields:

- discretization

Options can be printed directly to screen, e.g.

```
print(get_kdvv_options())
```

String representation can be generated by

```
repr(get_kdvv_options())
```



## NONLINEAR SCHROEDINGER EQUATION WITH PERIODIC BOUNDARIES

### 4.1 nsep - calculate the Nonlinear Fourier Transform

`FNFTpy.fnft_nsep_wrapper.nsep(q, T1, T2, kappa=1, loc=None, filt=None, bb=None, maxev=None, dis=None, nf=None, floq_range=None, pp-spine=None, dsub=None, tol=None)`

Calculate the Nonlinear Fourier Transform for the Nonlinear Schroedinger equation with periodic boundaries.

This function is intended to be 'convenient', which means it automatically calculates some variables needed to call the C-library and uses some default options. Own options can be set by passing optional arguments (see below). Options can be set by passing optional arguments (see below).

It converts all Python input into the C equivalent and returns the result from FNFT. If a more C-like interface is desired, the function 'nsep\_wrapper' can be used (see documentation there).

Arguments:

- `q` : numpy array holding the samples of the input field
- `T1, T2` : time positions of the first and the (D+1) sample, where D is the number of samples

Optional arguments:

- `kappa` : +/- 1 for focussing/defocussing nonlinearity, default = 1
- `loc` : localization method for the spectrum, default = 2
  - 0 = subsample and refine
  - 1 = gridsearch
  - 2 = mixed
- `filt` : filtering of spectrum, default = 2
  - 0 = none
  - 1 = manual
  - 2 = auto
- `bb`: bounding box used for manual filtering, default = [-inf, inf, -inf, inf]
- `maxev` : maximum number of evaluations for root refinement, default = 20
- `nf` : normalization flag default = 1
  - 0 = off
  - 1 = on
- `dis` : discretization, default = 4
  - 0 = 2SPLIT2\_MODAL

- 1 = BO
- 2 = 2SPLIT1A
- 3 = 2SPLIT1B
- 4 = 2SPLIT2A
- 5 = 2SPLIT2B
- 6 = 2SPLIT2S
- 7 = 2SPLIT3A
- 8 = 2SPLIT3B
- 9 = 2SPLIT3S
- 10 = 2SPLIT4A
- 11 = 2SPLIT4B
- 12 = 2SPLIT5A
- 13 = 2SPLIT5B
- 14 = 2SPLIT6A
- 15 = 2SPLIT6B
- 16 = 2SPLIT7A
- 17 = 2SPLIT7B
- 18 = 2SPLIT8A
- 19 = 2SPLIT8B
- nf : normalization flag, default=1
  - 0 = off
  - 1 = on
- floq\_range : array of two reals defining Floquet range, default = [-1, 1]
- ppspin : points per spine: defining the grid between interval set by floq\_range
- dsub : approximate number of samples for ‘subsample and refine’ localization
- tol : Tolerance, for root search refinement. Can be either positive number or (default =-1 (=auto))

Returns:

- rdict : dictionary holding the fields (depending on options)
  - return\_value : return value from FNFT
  - K : number of points in the main spectrum
  - main : main spectrum
  - M: number of points in the auxiliary spectrum
  - aux: auxiliary spectrum
  - options : NsepOptionsStruct with options used

## 4.2 nsep\_wrapper - interact with FNFT library

`FNFTpy.fnft_nsep_wrapper.nsep_wrapper` (*D, q, T1, T2, kappa, options*)

Calculate the Nonlinear Fourier Transform for the Nonlinear Schroedinger equation with periodic boundaries.

This function's interface mimics the behavior of the function 'fnft\_nsep' of FNFT. It converts all Python input into the C equivalent and returns the result from FNFT. If a more simplified version is desired, 'nsep' can be used (see documentation there).

Arguments:

- *D* : number of sample points
- *q* : numpy array holding the samples of the input field
- *T1, T2* : time positions of the first and the (*D*+1) sample
- *kappa* : +/- 1 for focussing/defocussing nonlinearity
- *options* : options for nsep as NsepOptionsStruct. Can be generated e.g. with 'get\_nsep\_options()'

Returns:

- *rdict* : dictionary holding the fields (depending on options)
  - *return\_value* : return value from FNFT
  - *K* : number of points in the main spectrum
  - *main* : main spectrum
  - *M*: number of points in the auxiliary spectrum
  - *aux*: auxiliary spectrum
  - *options* : NsepOptionsStruct with options used

## 4.3 get, set and print options for nsep wrapper

`FNFTpy.options_handling.fnft_nsep_default_options_wrapper` ()

Get the default options for nsep directly from the FNFT C-library.

Returns:

- *options* : NsepOptionsStruct for nsep\_wrapper

`FNFTpy.options_handling.get_nsep_options` (*loc=None, filt=None, bb=None, maxev=None, dis=None, nf=None, floq\_range=None, ppspine=None, dsub=None, tol=None*)

Get a NsepOptionsStruct struct for use with nsep\_wrapper.

When called without additional optional argument, the default values from FNFT are used.

Optional arguments:

- *loc* : localization method for the spectrum, default = 2
  - 0 = subsample and refine
  - 1 = gridsearch
  - 2 = mixed
- *filt* : filtering of spectrum, default = 2
  - 0 = none

- 1 = manual
- 2 = auto
- **bb**: bounding box used for manual filtering, default =  $[-\text{inf}, \text{inf}, -\text{inf}, \text{inf}]$
- **maxev** : maximum number of evaluations for root refinement, default = 20
- **dis** : discretization, default = 4
  - 0 = 2SPLIT2\_MODAL
  - 1 = BO
  - 2 = 2SPLIT1A
  - 3 = 2SPLIT1B
  - 4 = 2SPLIT2A
  - 5 = 2SPLIT2B
  - 6 = 2SPLIT2S
  - 7 = 2SPLIT3A
  - 8 = 2SPLIT3B
  - 9 = 2SPLIT3S
  - 10 = 2SPLIT4A
  - 11 = 2SPLIT4B
  - 12 = 2SPLIT5A
  - 13 = 2SPLIT5B
  - 14 = 2SPLIT6A
  - 15 = 2SPLIT6B
  - 16 = 2SPLIT7A
  - 17 = 2SPLIT7B
  - 18 = 2SPLIT8A
  - 19 = 2SPLIT8B
- **nf** : normalization flag, default=1
  - 0 = off
  - 1 = on
- **floq\_range** : array of two reals defining Floquet range, default =  $[-1, 1]$
- **ppspine** : points per spine: defining the grid between interval set by **floq\_range**
- **dsub** : approximate number of samples for ‘subsample and refine’ localization
- **tol** : Tolerance, for root search refinement. Can be either positive number or (default = -1 (=auto))

Returns:

- **options** : NsepOptionsStruct

`FNFTpy.options_handling.print_nsep_options (options=None)`

Print options of a NsepOptionsStruct.

When called without additional arguments, the default options from FNFT are printed.

Optional arguments:

- **options** : NsepOptionsStruct, e.g. created by `get_nsep_options`



## 4.4 options NsepOptionsStruct

**class** FNFTpy.typesdef.NsepOptionsStruct  
Ctypes options struct for interfacing fnft\_nsep.

Fields:

- localization
- filtering
- bounding\_box
- max\_evals
- discretization
- normalization\_flag
- floquet\_range
- points\_per\_spine
- dsub
- tolerance

Options can be printed directly to screen, e.g.

```
print(get_nsep_options())
```

String representation can be generated by

```
repr(get_nsep_options())
```



## NONLINEAR SCHROEDINGER EQUATION WITH VANISHING BOUNDARIES

### 5.1 nsev - calculate the Nonlinear Fourier Transform

```
FNFTpy.fnft_nsev_wrapper.nsev(q, tvec, Xi1=-2, Xi2=2, M=128, K=128, kappa=1, bsf=None,
                               bsl=None, niter=None, Dsub=None, dst=None, cst=None,
                               nf=None, dis=None)
```

Calculate the Nonlinear Fourier Transform for the Nonlinear Schroedinger equation with vanishing boundaries.

This function is intended to be ‘convenient’, which means it automatically calculates some variables needed to call the C-library and uses some default options. Own options can be set by passing optional arguments (see below). Options can be set by passing optional arguments (see below).

It converts all Python input into the C equivalent and returns the result from FNFT. If a more C-like interface is desired, the function ‘nsev\_wrapper’ can be used (see documentation there).

Arguments:

- q : numpy array holding the samples of the input field
- tvec: time vector

Optional arguments:

- Xi1, Xi2 : min and max frequency for the continuous spectrum. default = -2,2
- M : number of values for the continuous spectrum to calculate default = 128
- K : maximum number of bound states to calculate default = 128
- kappa : +/- 1 for focussing/defocussing nonlinearity, default = 1
- bsf : bound state filtering, default = 2
  - 0 = none
  - 1 = basic
  - 2 = full
- bsl : bound state localization, default = 2
  - 0 = fast eigenvalue
  - 1 = Newton
  - 2 = subsample and refine
- niter : number of iterations for Newton bound state location, default = 10
- Dsub : number of samples used for ‘subsampling and refine’-method, default = 0 (auto)
- dst : type of discrete spectrum, default = 0
  - 0 = norming constants

- 1 = residues
- 2 = both
- 3 = skip computing discrete spectrum
- `est` : type of continuous spectrum, default = 0
  - 0 = reflection coefficient
  - 1 = a and b
  - 2 = both
  - 3 = skip computing continuous spectrum
- `dis` : discretization, default = 11
  - 0 = 2SPLIT2\_MODAL
  - 1 = BO
  - 2 = 2SPLIT1A
  - 3 = 2SPLIT1B
  - 4 = 2SPLIT2A
  - 5 = 2SPLIT2B
  - 6 = 2SPLIT2S
  - 7 = 2SPLIT3A
  - 8 = 2SPLIT3B
  - 9 = 2SPLIT3S
  - 10 = 2SPLIT4A
  - 11 = 2SPLIT4B
  - 12 = 2SPLIT5A
  - 13 = 2SPLIT5B
  - 14 = 2SPLIT6A
  - 15 = 2SPLIT6B
  - 16 = 2SPLIT7A
  - 17 = 2SPLIT7B
  - 18 = 2SPLIT8A
  - 19 = 2SPLIT8B
- `nf` : normalization flag, default = 1
  - 0 = off
  - 1 = on

Returns:

- `rdict` : dictionary holding the fields (depending on options)
  - `return_value` : return value from FNFT
  - `bound_states_num` : number of bound states found
  - `bound_states` : array of bound states found
  - `disc_norm` : discrete spectrum - norming constants
  - `disc_res` : discrete spectrum - residues

- `cont_ref` : continuous spectrum - reflection coefficient
- `cont_a` : continuous spectrum - scattering coefficient a
- `cont_b` : continuous spectrum - scattering coefficient b
- `options` : `NsepOptionsStruct` with the options used

## 5.2 nsev\_wrapper - interact with FNFT library

`FNFTpy.fnft_nsev_wrapper.nsev_wrapper` (*D, q, T1, T2, Xi1, Xi2, M, K, kappa, options*)

Calculate the Nonlinear Fourier Transform for the Nonlinear Schroedinger equation with vanishing boundaries.

This function's interface mimics the behavior of the function 'fnft\_nsev' of FNFT. It converts all Python input into the C equivalent and returns the result from FNFT. If a more simplified version is desired, 'nsev' can be used (see documentation there).

Arguments:

- `D` : number of sample points
- `q` : numpy array holding the samples of the field to be analyzed
- `T1, T2` : time positions of the first and the last sample
- `Xi1, Xi2` : min and max frequency for the continuous spectrum
- `M` : number of values for the continuous spectrum to calculate
- `K` : maximum number of bound states to calculate
- `kappa` : +/- 1 for focussing/defocussing nonlinearity
- `options` : options for nsev as `NsepOptionsStruct`

Returns:

- `rdict` : dictionary holding the fields (depending on options)
  - `return_value` : return value from FNFT
  - `bound_states_num` : number of bound states found
  - `bound_states` : array of bound states found
  - `disc_norm` : discrete spectrum - norming constants
  - `disc_res` : discrete spectrum - residues
  - `cont_ref` : continuous spectrum - reflection coefficient
  - `cont_a` : continuous spectrum - scattering coefficient a
  - `cont_b` : continuous spectrum - scattering coefficient b
  - `options` : `NsepOptionsStruct` with the options used

## 5.3 get, set and print options for nsep wrapper

`FNFTpy.options_handling.fnft_nsev_default_options_wrapper()`

Get the default options for nsev directly from the FNFT C-library.

Returns:

- options : NsevOptionsStruct with options for nsev\_wrapper

`FNFTpy.options_handling.get_nsev_options(bsf=None, bsl=None, niter=None, Dsub=None, dst=None, cst=None, nf=None, dis=None)`

Get a NsevOptionsStruct for use with nsev\_wrapper.

When called without additional optional arguments, the default values from FNFT are used.

Optional arguments:

- bsf : bound state filtering, default = 2
  - 0 = none
  - 1 = basic
  - 2 = full
- bsl : bound state localization, default = 2
  - 0 = fast eigenvalue
  - 1 = Newton
  - 2 = subsample and refine
- niter : number of iterations for Newton bound state location, default = 10
- Dsub : number of samples used for ‘subsampling and refine’-method, default = 0 (auto)
- dst : type of discrete spectrum, default = 0
  - 0 = norming constants
  - 1 = residues
  - 2 = both
  - 3 = skip computing discrete spectrum
- cst : type of continuous spectrum, default = 0
  - 0 = reflection coefficient
  - 1 = a and b
  - 2 = both
  - 3 = skip computing continuous spectrum
- dis : discretization, default = 11
  - 0 = 2SPLIT2\_MODAL
  - 1 = BO
  - 2 = 2SPLIT1A
  - 3 = 2SPLIT1B
  - 4 = 2SPLIT2A
  - 5 = 2SPLIT2B
  - 6 = 2SPLIT2S
  - 7 = 2SPLIT3A

- 8 = 2SPLIT3B
- 9 = 2SPLIT3S
- 10 = 2SPLIT4A
- 11 = 2SPLIT4B
- 12 = 2SPLIT5A
- 13 = 2SPLIT5B
- 14 = 2SPLIT6A
- 15 = 2SPLIT6B
- 16 = 2SPLIT7A
- 17 = 2SPLIT7B
- 18 = 2SPLIT8A
- 19 = 2SPLIT8B
- nf : normalization flag, default = 1
  - 0 = off
  - 1 = on

Returns:

- options : NsevOptionsStruct

`FNFTpy.options_handling.print_nsev_options (options=None)`

Print options of a NsevOptionsStruct.

When called without additional argument, the default options from FNFT are printed.

Optional arguments:

- options : NsevOptionsStruct, e.g. created by `get_nsev_options()`

## 5.4 options NsevOptionsStruct

**class** `FNFTpy.typesdef.NsevOptionsStruct`

Ctypes options struct for interfacing `fnft_nsev`.

Fields:

- bound\_state\_filtering
- bound\_state\_localization
- Dsub
- niter
- discspec\_type
- contspec\_type
- normalization\_flag
- discretization

Options can be printed directly to screen, e.g.

```
print(get_nsev_options())
```

String representation can be generated by

```
repr(get_nsev_options())
```





## NONLINEAR SCHROEDINGER EQUATION WITH VANISHING BOUNDARIES - INVERSE NONLINEAR FOURIER TRANSFORM

### 6.1 nsev\_inverse\_xi\_wrapper

`FNFTpy.nsev_inverse_xi_wrapper(D, T1, T2, M, dis=None)`

Helper function for `nsev_inverse` to calculate the spectral borders for a given time window.

Return value is an array holding the position of the first and the last spectral sample to be used for `nsev_inverse`.

Arguments:

- D : number of sample points for the time window
- T1, T2 : borders of the time window
- M : number of samples for the continuous spectrum

Optional Arguments:

- dis : nse discretization parameter, default = 4
  - 0 = 2SPLIT2\_MODAL
  - 1 = BO
  - 2 = 2SPLIT1A
  - 3 = 2SPLIT1B
  - 4 = 2SPLIT2A
  - 5 = 2SPLIT2B
  - 6 = 2SPLIT2S
  - 7 = 2SPLIT3A
  - 8 = 2SPLIT3B
  - 9 = 2SPLIT3S
  - 10 = 2SPLIT4A
  - 11 = 2SPLIT4B
  - 12 = 2SPLIT5A
  - 13 = 2SPLIT5B
  - 14 = 2SPLIT6A
  - 15 = 2SPLIT6B
  - 16 = 2SPLIT7A
  - 17 = 2SPLIT7B

- 18 = 2SPLIT8A
- 19 = 2SPLIT8B

Returns:

- `rv` : return value of the C-function
- `xi` : two-element C double vector containing XI borders

## 6.2 `nsev_inverse` - calculate the Inverse Nonlinear Fourier Transform

```
FNFTpy.fnft_nsev_inverse_wrapper.nsev_inverse(xivec, tvec, contspec, bound_states,  
                                              discspec, dis=None, cst=None,  
                                              csim=None, dst=None,  
                                              max_iter=None, osf=None,  
                                              kappa=1)
```

Calculate the Inverse Nonlinear Fourier Transform for the Nonlinear Schroedinger equation with vanishing boundaries.

This function is intended to be ‘clutter-free’, which means it automatically calculates some variables needed to call the C-library. Options can be set by passing optional arguments (see below). It converts all Python input into the C equivalent and returns the result from FNFT. If a more C-like interface is desired, the function ‘`nsev_inverse_wrapper`’ can be used (see documentation there).

**!!! Attention: time and frequency vector can not be choosen independently (yet).** use `nsev_inverse_xi_wrapper` to calculate `xivec` from `tvec` !!!

Arguments:

- `xivec`: frequency vector
- `tvec`: time vector
- `contspec`: continuous spectrum (of `xi`). Pass `None` if for pure soliton state.
- `bound_states`: array holding the bound states. Pass `None` if no bound states present.
- `discspec`: discrete spectrum. Pass `None` if no bound states present.

Optional arguments:

- `dis` : discretization, default = 4
  - 0 = 2SPLIT2\_MODAL
  - 1 = BO
  - 2 = 2SPLIT1A
  - 3 = 2SPLIT1B
  - 4 = 2SPLIT2A
  - 5 = 2SPLIT2B
  - 6 = 2SPLIT2S
  - 7 = 2SPLIT3A
  - 8 = 2SPLIT3B
  - 9 = 2SPLIT3S
  - 10 = 2SPLIT4A
  - 11 = 2SPLIT4B
  - 12 = 2SPLIT5A

- 13 = 2SPLIT5B
- 14 = 2SPLIT6A
- 15 = 2SPLIT6B
- 16 = 2SPLIT7A
- 17 = 2SPLIT7B
- 18 = 2SPLIT8A
- 19 = 2SPLIT8B
- `cst` : type of continuous spectrum, default = 0
  - 0 = Reflection coefficient
  - 1 = b of xi
  - 2 = b of tau
- `csim` : inversion method for the continuous part, default = 0
  - 0 = default
  - 1 = Transfermatrix with reflection coefficients
  - 2 = Transfermatrix with a,b from iteration
  - 3 = seed potential
- `dst` : type of discrete spectrum, default = 0
  - 0 = norming constants
  - 1 = residues
- `max_iter` : maximum number of iterations for iterative methods, default = 100
- `osf` : oversampling factor, default = 8

### 6.3 nsev\_inverse\_wrapper - interact with FNFT library

`FNFTpy.fnft_nsev_inverse_wrapper.nsev_inverse_wrapper` (*M, contspec, Xi1, Xi2, K, bound\_states, normconst\_or\_residues, D, T1, T2, kappa, options*)

Calculate the Inverse Nonlinear Fourier Transform for the Nonlinear Schroedinger equation with vanishing boundaries.

This function's interface mimics the behavior of the function 'fnft\_nsev\_inverse' of FNFT. It converts all Python input into the C equivalent and returns the result from FNFT. If a more simplified version is desired, 'nsev\_inverse' can be used (see documentation there).

Arguments:

- `M` : number of sample points for continuous spectrum
- `contspec` : numpy array holding the samples of the continuous spectrum (can be None if M=0)
- `Xi1, Xi2` [frequencies defining the frequency range of the continuous spectrum.] ! Currently, the positions returned by `nsev_inverse_xi_wrapper` must be used !
- `K` : number of bound states
- `bound_states` : bound states (can be None if K=0)
- `normconst_or_residues` : bound state spectral coefficients (can be None if K=0)
- `D` : number of samples for the output field

- T1, T2 : borders of the desired time window
- kappa : +1/-1 for focussing / defocussing NSE
- options : options for nsev\_inverse as NsevInverseOptionsStruct

Returns:

- rdict : dictionary holding the fields (depending on options)
  - return\_value : return value from FNFT
  - q : time field resulting from inverse transform
  - options : options for nsev\_inverse as NsevInverseOptionsStruct

## 6.4 get, set and print options for nsev\_inverse\_wrapper

`FNFTpy.options_handling.fnft_nsev_inverse_default_options_wrapper()`

Get the default options for nsev\_inverse directly from the FNFT C-library.

Returns:

- options : NsevInverseOptionsStruct with options for nsev\_inverse\_wrapper

`FNFTpy.options_handling.get_nsev_inverse_options(dis=None, cst=None, csim=None, dst=None, max_iter=None, osf=None)`

Get a NsevInverseOptionsStruct for use with nsev\_inverse\_wrapper.

When called without additional optional arguments, the default values from FNFT are used.

Optional arguments:

- dis : discretization, default = 4
  - 0 = 2SPLIT2\_MODAL
  - 1 = BO
  - 2 = 2SPLIT1A
  - 3 = 2SPLIT1B
  - 4 = 2SPLIT2A
  - 5 = 2SPLIT2B
  - 6 = 2SPLIT2S
  - 7 = 2SPLIT3A
  - 8 = 2SPLIT3B
  - 9 = 2SPLIT3S
  - 10 = 2SPLIT4A
  - 11 = 2SPLIT4B
  - 12 = 2SPLIT5A
  - 13 = 2SPLIT5B
  - 14 = 2SPLIT6A
  - 15 = 2SPLIT6B
  - 16 = 2SPLIT7A
  - 17 = 2SPLIT7B
  - 18 = 2SPLIT8A

- 19 = 2SPLIT8B
- `cst` : type of continuous spectrum, default = 0
  - 0 = Reflection coefficient
  - 1 = b of xi
  - 2 = b of tau
- `csim` : inversion method for the continuous part, default = 0
  - 0 = default
  - 1 = Transfermatrix with reflection coefficients
  - 2 = Transfermatrix with a,b from iteration
  - 3 = seed potential
- `dst` : type of discrete spectrum, default = 0
  - 0 = norming constants
  - 1 = residues
- `max_iter` : maximum number of iterations for iterative methods, default = 100
- `osf` : oversampling factor, default = 8

Returns:

- `options` : `NsevInverseOptionsStruct`

`FNFTpy.options_handling.print_nsev_inverse_options(options=None)`

Print options of a `NsevInverseOptionsStruct` for `nsev_inverse`.

When called without additional argument, the default options from FNFT are printed.

Optional arguments:

- `options` : `NsevInverseOptionsStruct`, e.g. created by `get_nsev_options()`

## 6.5 options `NsevInverseOptionsStruct`

**class** `FNFTpy.typesdef.NsevInverseOptionsStruct`

Ctypes options struct for interfacing `fnft_nsev_inverse`.

Fields:

- `discretization`
- `contspec_type`
- `contspec_inversion_method`
- `discspec_type`
- `max_iter`
- `oversampling_factor`

Options can be printed directly to screen, e.g.

```
print(get_nsev_inverse_options())
```

String representation can be generated by

```
repr(get_nsev_inverse_options())
```



## PYTHON MODULE INDEX

### f

`FNFTpy`, [1](#)





## F

fnft\_kdvv\_default\_options\_wrapper() (in module *FNFTpy.options\_handling*), 6  
 fnft\_nsep\_default\_options\_wrapper() (in module *FNFTpy.options\_handling*), 11  
 fnft\_nsev\_default\_options\_wrapper() (in module *FNFTpy.options\_handling*), 18  
 fnft\_nsev\_inverse\_default\_options\_wrapper() (in module *FNFTpy.options\_handling*), 24  
 FNFTpy (module), 1

## G

get\_fnft\_version() (in module *FNFTpy*), 3  
 get\_kdvv\_options() (in module *FNFTpy.options\_handling*), 6  
 get\_lib\_path() (in module *FNFTpy*), 3  
 get\_nsep\_options() (in module *FNFTpy.options\_handling*), 11  
 get\_nsev\_inverse\_options() (in module *FNFTpy.options\_handling*), 24  
 get\_nsev\_options() (in module *FNFTpy.options\_handling*), 18

## K

kdvv() (in module *FNFTpy.fnft\_kdvv\_wrapper*), 5  
 kdvv\_wrapper() (in module *FNFTpy.fnft\_kdvv\_wrapper*), 6  
 KdvvOptionsStruct (class in *FNFTpy.typesdef*), 7

## N

nsep() (in module *FNFTpy.fnft\_nsep\_wrapper*), 9  
 nsep\_wrapper() (in module *FNFTpy.fnft\_nsep\_wrapper*), 11  
 NsepOptionsStruct (class in *FNFTpy.typesdef*), 13  
 nsev() (in module *FNFTpy.fnft\_nsev\_wrapper*), 15  
 nsev\_inverse() (in module *FNFTpy.fnft\_nsev\_inverse\_wrapper*), 22  
 nsev\_inverse\_wrapper() (in module *FNFTpy.fnft\_nsev\_inverse\_wrapper*), 23  
 nsev\_inverse\_xi\_wrapper() (in module *FNFTpy*), 21  
 nsev\_wrapper() (in module *FNFTpy.fnft\_nsev\_wrapper*), 17

NsevInverseOptionsStruct (class in *FNFTpy.typesdef*), 25  
 NsevOptionsStruct (class in *FNFTpy.typesdef*), 19

## P

print\_fnft\_version() (in module *FNFTpy*), 3  
 print\_kdvv\_options() (in module *FNFTpy.options\_handling*), 7  
 print\_nsep\_options() (in module *FNFTpy.options\_handling*), 12  
 print\_nsev\_inverse\_options() (in module *FNFTpy.options\_handling*), 25  
 print\_nsev\_options() (in module *FNFTpy.options\_handling*), 19