iir1

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1 DSP IIR Realtime C++ filter library

An infinite impulse response (IIR) filter library for Linux, Mac OSX and Windows which implements Butterworth, RBJ, Chebychev filters and can easily import coefficients generated by Python (scipy).

The filter processes the data sample by sample for realtime processing.

It uses templates to allocate the required memory so that it can run without any malloc / new commands. Memory is allocated at compile time so that there is never the risk of memory leaks.

1.1 C++ code

Add the following include statement to your code:

```
#include "Iir.h"
```

The general coding approach is that first the filter is instantiated specifying its order, then the parameters are set with the function `setup` and then it's ready to be used for sample by sample realtime filtering.

1.1.1 Setting the filter parameters

All filters are available as lowpass, highpass, bandpass and bandstop/notch filters. Butterworth / Chebyshev offer also low/high/band-shelves with specified passband gain and 0dB gain in the stopband.

The frequencies can either be analogue ones against the sampling rate or normalised ones between 0..1/2 where 1/2 is the Nyquist frequency. Note that normalised frequencies are simply f = F/Fs and are in units of 1/samples. Internally the library uses normalised frequencies and the setup commands simply divide by the sampling rate if given. Choose between:

1. `setup`: sampling rate and the analogue cutoff frequencies
2. `setupN`: normalised frequencies in 1/samples between f = 0..1/2 where 1/2 = Nyquist.

See the header files in `\iir` or the documentation for the arguments of the `setup` commands.

The examples below are for lowpass filters:

1. Butterworth – `Butterworth.h` Standard filter suitable for most applications. Monotonic response.

   ```
   const int order = 4; // 4th order (=2 biquads)
   Iir::Butterworth::LowPass<order> f;
   const float samplingrate = 1000; // Hz
   const float cutoff_frequency = 5; // Hz
   f.setup (samplingrate, cutoff_frequency);
   ```

or specify a normalised frequency between 0..1/2:

```
f.setupN(norm_cutoff_frequency);
```

1. Chebyshev Type I – `ChebyshevI.h` With permissible passband ripple in dB.

   ```
   Iir::ChebyshevI::LowPass<order> f;
   const float passband_ripple_in_db = 5;
   f.setup (samplingrate,
            cutoff_frequency,
            passband_ripple_in_dB);
   ```

or specify a normalised frequency between 0..1/2:

```
f.setupN(norm_cutoff_frequency,passband_ripple_in_dB);
```

1. Chebyshev Type II – `ChebyshevII.h` With worst permissible stopband rejection in dB.

   ```
   Iir::ChebyshevII::LowPass<order> f;
   double stopband_ripple_in_dB = 20;
   f.setup (samplingrate,
            cutoff_frequency,
            stopband_ripple_in_dB);
   ```

or specify a normalised frequency between 0..1/2:

```
f.setupN(norm_cutoff_frequency,stopband_ripple_in_dB);
```

1. RBJ – `RBJ.h` 2nd order filters with cutoff and Q factor.

   ```
   Iir::RBJ::LowPass f;
   const float cutoff_frequency = 100;
   const float Q_factor = 5;
   f.setup (samplingrate, cutoff_frequency, Q_factor);
   ```

or specify a normalised frequency between 0..1/2:

```
f.setupN(norm_cutoff_frequency, Q_factor);
```

1. Designing filters with Python's scipy.signal – `Custom.h`

   ```
   ########
   # Python
   # See "elliptic_design.py" for the complete code.
   from scipy import signal
   order = 4
   sos = signal.ellip(order, 5, 40, 0.2, ’low’, output=’sos’)
   print(sos) # copy/paste the coefficients over & replace [] with {}
   ///////
   // C++
   // part of "iirdemo.cpp"
   const double coeff[][6] = {
                   {1.665623674062209972e-02,
                    -3.924801366970616552e-03,
                    1.665623674062210319e-02,
                    1.000000000000000000e+00,
                    -1.715403014004022175e+00,
                    8.100474793174089472e-01},
                   {1.000000000000000000e+00,
                    -1.369778997100624895e+00,
                    1.000000000000000222e+00,
                    1.000000000000000000e+00,
                    -1.605878925999785656e+00,
                    9.538657786383895054e-01}
           };
   const int nSOS = sizeof(coeff) / sizeof(coeff[0]); // here: nSOS = 2 = order / 2
   Iir::Custom::SOSCascade<nSOS> cust(coeff);
   ```

1.1.2 Realtime filtering sample by sample

Samples are processed one by one. In the example below a sample `x` is processed with the `filter` command and then saved in `y`. The types of `x` and `y` can either be float or double (integer is also allowed but is still processed internally as floating point):

```
y = f.filter(x);
```

This is then repeated for every incoming sample in a loop or event handler.

1.1.3 Error handling

Invalid values provided to `setup()` will throw an exception. Parameters provided to `setup()` which result in coefficients being NAN will also throw an exception.

1.2 Linking

1.2.1 CMake setup

If you use cmake as your build system then just add to your `CMakeLists.txt` the following lines for the dynamic library:

```
find_package(iir)
target_link_libraries(... iir::iir)
```

or for the static one:

```
find_package(iir)
target_link_libraries(... iir::iir_static)
```

1.2.2 Generic linker setup

Link it against the dynamic library (Unix/Mac: `-liir`, Windows: `iir.lib`) or the static library (Unix/Mac↩ : `libiir_static.a`, Windows: `libiir_static.lib`).

1.3 Packages for Ubuntu (xenial / bionic / focal):

If you have Ubuntu's LTS distros xenial, bionic or focal then install it as a pre-compiled package:

```
sudo add-apt-repository ppa:berndporr/dsp
```

It's available for 32,64 bit PC and 32,64 bit ARM (Raspberry PI etc). The documentation and the example programs are in:

```
/usr/share/doc/iir1-dev/
```

1.4 Package for MacOS

Make sure you have the homebrew package manager installed: `https://brew.sh/`

Add the homebrew tap:

```
brew tap berndporr/dsp
```

and then install the iir filter package with:

```
brew install iir
```

1.5 Compilation from source

The build tool is `cmake` which generates the make- or project files for the different platforms. `cmake` is available for Linux, Windows and Mac. It also compiles directly on a Raspberry PI.

1.5.1 Linux / Mac

Run

```
cmake .
```

which generates the Makefile. Then run:

```
make
sudo make install
```

which installs it under `/usr/local/lib` and `/usr/local/include`.

Both gcc and clang have been tested.

1.5.2 Windows

```
cmake -G "Visual Studio 15 2017 Win64" .
```

See `cmake` for the different build-options. Above is for a 64 bit build. Then start Visual C++ and open the solution. This will create the DLL and the LIB files. Under Windows it's highly recommended to use the static library and link it into the application program.

1.5.3 Unit tests

Run unit tests by typing `make test` or just `ctest`. These test if after a delta pulse all filters relax to zero and that their outputs never become NaN.

1.6 Documentation

1.6.1 Learn from the demos

The easiest way to learn is from the examples which are in the `demo` directory. A delta pulse as a test signal is sent into the different filters and saved in a file. With the Python script `plot_impulse_fresponse.py` you can then plot the frequency responses.

Also the directory containing the unit tests provides examples for every filter type.

1.6.2 Detailed documentation

A PDF of all classes, methods and in particular `setup` functions is in the `docs/pdf` directory.

The online documentation is here: http://berndporr.github.io/iir1

1.7 Example filter responses

These responses have been generated by `iirdemo.cpp` in the `/demo/` directory and then plotted with `plot_impulse_fresponse.py`.

1.8 Credits

This library has been further developed from Vinnie Falco's great original work which can be found here:

https://github.com/vinniefalco/DSPFilters

While the original library processes audio arrays this library has been adapted to do fast realtime processing sample by sample. The `setup` command won't require the filter order and instead remembers it from the template argument. The class structure has been simplified and all functions documented for doxygen. Instead of having assert() statements this libary throws exceptions in case a parameter is wrong. Any filter design requiring optimisation (for example Ellipic filters) has been removed and instead a function has been added which can import easily coefficients from scipy.

1.9 Bibliography

```
"High-Order Digital Parametric Equalizer Design"
 Sophocles J. Orfanidis
 (Journal of the Audio Engineering Society, vol 53. pp 1026-1046)
"Spectral Transformations for digital filters"
 A. G. Constantinides, B.Sc.(Eng.) Ph.D.
 (Proceedings of the IEEE, vol. 117, pp. 1585-1590, August 1970)
```

Enjoy!

Bernd Porr – http://www.berndporr.me.uk

2 Namespace Index

2.1 Namespace List

Here is a list of all documented namespaces with brief descriptions:

3 Hierarchical Index

3.1 Class Hierarchy

This inheritance list is sorted roughly, but not completely, alphabetically:

BandPassBase

4 Class Index

4.1 Class List

Here are the classes, structs, unions and interfaces with brief descriptions:

5 Namespace Documentation

5.1 Iir Namespace Reference

Namespaces

- Butterworth
- ChebyshevI
- ChebyshevII
- Custom

Classes

- class BandPassTransform
- class BandStopTransform
- class Biquad
- struct BiquadPoleState
- class Cascade
- class CascadeStages
- struct ComplexPair
- class DirectFormI
- class DirectFormII
- class HighPassTransform
- class Layout
- class LayoutBase
- class LowPassTransform
- struct PoleFilter
- class PoleFilterBase
- class PoleFilterBase2
- struct PoleZeroPair
- class TransposedDirectFormII

Enumerations

- enum Kind

5.1.1 Detailed Description

"A Collection of Useful C++ Classes for Digital Signal Processing" By Vinnie Falco and Bernd Porr

Official project location: https://github.com/berndporr/iir1

See Documentation.cpp for contact information, notes, and bibliography.

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The above copyright notice and this permission notice shall be included in all copies or substantial portions of the Software.

THE SOFTWARE IS PROVIDED "AS IS", WITHOUT WARRANTY OF ANY KIND, EXPRESS OR IMPLIED, INCLUDING BUT NOT LIMITED TO THE WARRANTIES OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE AND NONINFRINGEMENT. IN NO EVENT SHALL THE AUTHORS OR COPYRIGHT HOLDERS BE LIABLE FOR ANY CLAIM, DAMAGES OR OTHER LIABILITY, WHETHER IN AN ACTION OF CONTRACT, TORT OR OTHERWISE, ARISING FROM, OUT OF OR IN CONNECTION WITH THE SOFTWARE OR THE USE OR OTHER DEALINGS IN THE SOFTWARE. Describes a filter as a collection of poles and zeros along with normalization information to achieve a specified gain at a specified frequency. The poles and zeros may lie either in the s or the z plane.

5.1.2 Enumeration Type Documentation

5.1.2.1 Kind `enum Iir::Kind`

Identifies the general class of filter

5.2 Iir::Butterworth Namespace Reference

Classes

- class AnalogLowPass
- class AnalogLowShelf
- struct BandPass
- struct BandPassBase
- struct BandShelf
- struct BandShelfBase
- struct BandStop
- struct BandStopBase
- struct HighPass
- struct HighPassBase
- struct HighShelf
- struct HighShelfBase
- struct LowPass

- struct LowPassBase
- struct LowShelf
- struct LowShelfBase

5.2.1 Detailed Description

Filters with Butterworth response characteristics. The filter order is usually set via the template parameter which reserves the correct space and is then automatically passed to the setup function. Optionally one can also provde the filter order at setup time to force a lower order than the default one.

5.3 Iir::ChebyshevI Namespace Reference

Classes

- class AnalogLowPass
- class AnalogLowShelf
- struct BandPass
- struct BandPassBase
- struct BandShelf
- struct BandShelfBase
- struct BandStop
- struct BandStopBase
- struct HighPass
- struct HighPassBase
- struct HighShelf
- struct HighShelfBase
- struct LowPass
- struct LowPassBase
- struct LowShelf
- struct LowShelfBase

5.3.1 Detailed Description

Filters with Chebyshev response characteristics. The last parameter defines the passband ripple in decibel.

5.4 Iir::ChebyshevII Namespace Reference

Classes

- class AnalogLowPass
- class AnalogLowShelf
- struct BandPass
- struct BandPassBase
- struct BandShelf
- struct BandShelfBase
- struct BandStop
- struct BandStopBase
- struct HighPass
- struct HighPassBase
- struct HighShelf
- struct HighShelfBase
- struct LowPass
- struct LowPassBase
- struct LowShelf
- struct LowShelfBase

5.4.1 Detailed Description

Filters with ChebyshevII response characteristics. The last parameter defines the minimal stopband rejection requested. Generally there will be frequencies where the rejection is much better but this parameter guarantees that the rejection is at least as specified.

5.5 Iir::Custom Namespace Reference

Classes

- struct OnePole
- struct SOSCascade
- struct TwoPole

5.5.1 Detailed Description

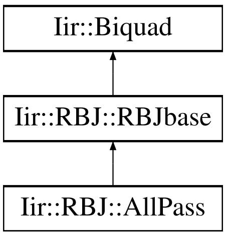
Single pole, Biquad and cascade of Biquads with parameters allowing for directly setting the parameters.

6 Class Documentation

6.1 Iir::RBJ::AllPass Struct Reference

```
#include <RBJ.h>
```

Inheritance diagram for Iir::RBJ::AllPass:



Public Member Functions

- void setupN (double phaseFrequency, double q=(1/sqrt(2)))
- void setup (double sampleRate, double phaseFrequency, double q=(1/sqrt(2)))

6.1.1 Detailed Description

Allpass filter

6.1.2 Member Function Documentation

6.1.2.1 setup()

```
void Iir::RBJ::AllPass::setup (
            double sampleRate,
            double phaseFrequency,
            double q = (1/sqrt(2)) )  [inline]
```

Calculates the coefficients

Parameters

sampleRate	Sampling rate
phaseFrequency	Frequency where the phase flips
q	Q-factor

6.1.2.2 setupN()

```
void Iir::RBJ::AllPass::setupN (
            double phaseFrequency,
            double q = (1/sqrt(2)) )
```

Calculates the coefficients

Parameters

phaseFrequency	Normalised frequency where the phase flips
q	Q-factor

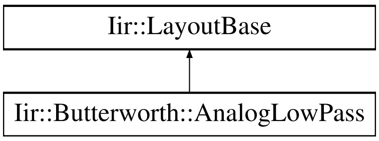
The documentation for this struct was generated from the following files:

- iir/RBJ.h
- iir/RBJ.cpp

6.2 Iir::Butterworth::AnalogLowPass Class Reference

`#include <Butterworth.h>`

Inheritance diagram for Iir::Butterworth::AnalogLowPass:



6.2.1 Detailed Description

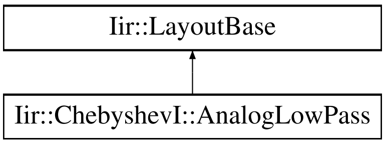
Analogue lowpass prototypes (s-plane)
The documentation for this class was generated from the following files:

- iir/Butterworth.h
- iir/Butterworth.cpp

6.3 Iir::ChebyshevI::AnalogLowPass Class Reference

`#include <ChebyshevI.h>`

Inheritance diagram for Iir::ChebyshevI::AnalogLowPass:



6.3.1 Detailed Description

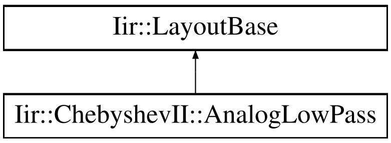
Analog lowpass prototypes (s-plane)
The documentation for this class was generated from the following files:

- iir/ChebyshevI.h
- iir/ChebyshevI.cpp

6.4 Iir::ChebyshevII::AnalogLowPass Class Reference

```
#include <ChebyshevII.h>
```

Inheritance diagram for Iir::ChebyshevII::AnalogLowPass:



6.4.1 Detailed Description

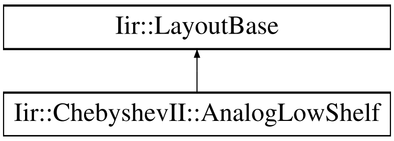
Analogue lowpass prototype (s-plane)
The documentation for this class was generated from the following files:

- iir/ChebyshevII.h
- iir/ChebyshevII.cpp

6.5 Iir::ChebyshevII::AnalogLowShelf Class Reference

```
#include <ChebyshevII.h>
```

Inheritance diagram for Iir::ChebyshevII::AnalogLowShelf:



6.5.1 Detailed Description

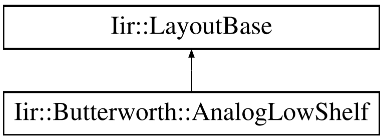
Analogue shelf lowpass prototype (s-plane)
The documentation for this class was generated from the following files:

- iir/ChebyshevII.h
- iir/ChebyshevII.cpp

6.6 Iir::Butterworth::AnalogLowShelf Class Reference

```
#include <Butterworth.h>
```

Inheritance diagram for Iir::Butterworth::AnalogLowShelf:



6.6.1 Detailed Description

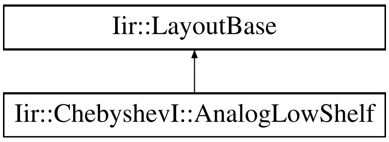
Analogue low shelf prototypes (s-plane)
The documentation for this class was generated from the following files:

- iir/Butterworth.h
- iir/Butterworth.cpp

6.7 Iir::ChebyshevI::AnalogLowShelf Class Reference

`#include <ChebyshevI.h>`

Inheritance diagram for Iir::ChebyshevI::AnalogLowShelf:



6.7.1 Detailed Description

Analog lowpass shelf prototype (s-plane)

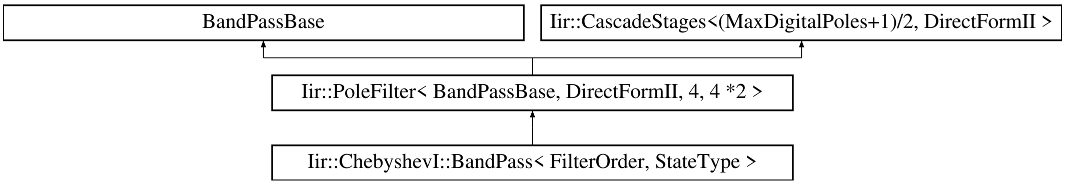
The documentation for this class was generated from the following files:

- iir/ChebyshevI.h
- iir/ChebyshevI.cpp

6.8 Iir::ChebyshevI::BandPass< FilterOrder, StateType > Struct Template Reference

`#include <ChebyshevI.h>`

Inheritance diagram for Iir::ChebyshevI::BandPass< FilterOrder, StateType >:


BandPassBase
Iir::CascadeStages<(MaxDigitalPoles+1)/2, DirectFormII >
Iir::PoleFilter< BandPassBase, DirectFormII, 4, 4 *2 >
Iir::ChebyshevI::BandPass< FilterOrder, StateType >

Public Member Functions

- void setup (double sampleRate, double centerFrequency, double widthFrequency, double rippleDb)
- void setup (int reqOrder, double sampleRate, double centerFrequency, double widthFrequency, double rippleDb)
- void setupN (double centerFrequency, double widthFrequency, double rippleDb)
- void setupN (int reqOrder, double centerFrequency, double widthFrequency, double rippleDb)

6.8.1 Detailed Description

template<int FilterOrder = 4, class StateType = DirectFormII>
struct Iir::ChebyshevI::BandPass< FilterOrder, StateType >

ChebyshevI bandpass filter

Parameters

FilterOrder	Reserves memory for a filter of the order FilterOrder
StateType	The filter topology: DirectFormI, DirectFormII, ...

6.8.2 Member Function Documentation

6.8.2.1 setup() [1/2] `template<int FilterOrder = 4, class StateType = DirectFormII>`

`void Iir::ChebyshevI::BandPass< FilterOrder, StateType >::setup (`

```
                double sampleRate,
                double centerFrequency,
                double widthFrequency,
                double rippleDb )  [inline]
```

Calculates the coefficients of the filter at the order FilterOrder

Parameters

sampleRate	Sampling rate
centerFrequency	Center frequency of the bandpass
widthFrequency	Frequency with of the passband
rippleDb	Permitted ripples in dB in the passband

6.8.2.2 setup() [2/2]

```
template<int FilterOrder = 4, class StateType = DirectFormII>
void Iir::ChebyshevI::BandPass< FilterOrder, StateType >::setup (
                int reqOrder,
                double sampleRate,
                double centerFrequency,
                double widthFrequency,
                double rippleDb )  [inline]
```

Calculates the coefficients of the filter at specified order

Parameters

reqOrder	Actual order for the filter calculations
sampleRate	Sampling rate
centerFrequency	Center frequency of the bandpass
widthFrequency	Frequency with of the passband
rippleDb	Permitted ripples in dB in the passband

6.8.2.3 setupN() [1/2]

```
template<int FilterOrder = 4, class StateType = DirectFormII>
void Iir::ChebyshevI::BandPass< FilterOrder, StateType >::setupN (
                double centerFrequency,
                double widthFrequency,
                double rippleDb )  [inline]
```

Calculates the coefficients of the filter at the order FilterOrder

Parameters

centerFrequency	Normalised center frequency (0..1/2) of the bandpass
widthFrequency	Frequency with of the passband
rippleDb	Permitted ripples in dB in the passband

6.8.2.4 setupN() [2/2]

```
template<int FilterOrder = 4, class StateType = DirectFormII>
void Iir::ChebyshevI::BandPass< FilterOrder, StateType >::setupN (
                int reqOrder,
                double centerFrequency,
                double widthFrequency,
                double rippleDb )  [inline]
```

Calculates the coefficients of the filter at specified order

Parameters

reqOrder	Actual order for the filter calculations
centerFrequency	Normalised center frequency (0..1/2) of the bandpass
widthFrequency	Frequency with of the passband
rippleDb	Permitted ripples in dB in the passband

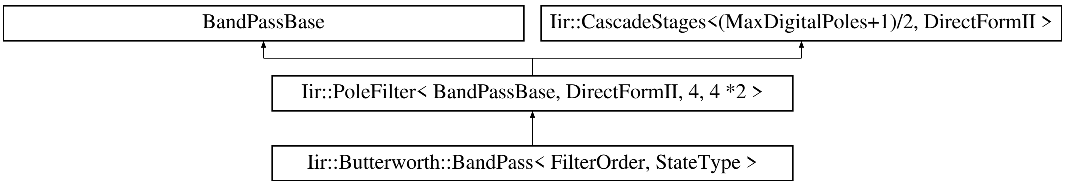
The documentation for this struct was generated from the following file:

- iir/ChebyshevI.h

6.9 Iir::Butterworth::BandPass< FilterOrder, StateType > Struct Template Reference

`#include <Butterworth.h>`

Inheritance diagram for Iir::Butterworth::BandPass< FilterOrder, StateType >:


BandPassBase
Iir::CascadeStages<(MaxDigitalPoles+1)/2, DirectFormII >
Iir::PoleFilter< BandPassBase, DirectFormII, 4, 4 *2 >
Iir::Butterworth::BandPass< FilterOrder, StateType >

Public Member Functions

- void setup (double sampleRate, double centerFrequency, double widthFrequency)
- void setup (int reqOrder, double sampleRate, double centerFrequency, double widthFrequency)
- void setupN (double centerFrequency, double widthFrequency)
- void setupN (int reqOrder, double centerFrequency, double widthFrequency)

6.9.1 Detailed Description

template<int FilterOrder = 4, class StateType = DirectFormII>
struct Iir::Butterworth::BandPass< FilterOrder, StateType >

Butterworth Bandpass filter.

Parameters

FilterOrder	Reserves memory for a filter of the order FilterOrder
StateType	The filter topology: DirectFormI, DirectFormII, ...

6.9.2 Member Function Documentation

6.9.2.1 setup() [1/2] template<int FilterOrder = 4, class StateType = DirectFormII>

```
void Iir::Butterworth::BandPass< FilterOrder, StateType >::setup (
            double sampleRate,
            double centerFrequency,
            double widthFrequency ) [inline]
```

Calculates the coefficients with the filter order provided by the instantiation

Parameters

sampleRate	Sampling rate
centerFrequency	Centre frequency of the bandpass
widthFrequency	Width of the bandpass

6.9.2.2 setup() [2/2]

```
template<int FilterOrder = 4, class StateType = DirectFormII>
void Iir::Butterworth::BandPass< FilterOrder, StateType >::setup (
            int reqOrder,
            double sampleRate,
            double centerFrequency,
            double widthFrequency )  [inline]
```

Calculates the coefficients

Parameters

reqOrder	The actual order which can be less than the instantiated one
sampleRate	Sampling rate
centerFrequency	Centre frequency of the bandpass
widthFrequency	Width of the bandpass

6.9.2.3 setupN() [1/2]

```
template<int FilterOrder = 4, class StateType = DirectFormII>
void Iir::Butterworth::BandPass< FilterOrder, StateType >::setupN (
            double centerFrequency,
            double widthFrequency )  [inline]
```

Calculates the coefficients with the filter order provided by the instantiation

Parameters

centerFrequency	Normalised centre frequency (0..1/2) of the bandpass
widthFrequency	Width of the bandpass in normalised freq

6.9.2.4 setupN() [2/2]

```
template<int FilterOrder = 4, class StateType = DirectFormII>
void Iir::Butterworth::BandPass< FilterOrder, StateType >::setupN (
            int reqOrder,
            double centerFrequency,
            double widthFrequency )  [inline]
```

Calculates the coefficients

Parameters

reqOrder	The actual order which can be less than the instantiated one
centerFrequency	Normalised centre frequency (0..1/2) of the bandpass
widthFrequency	Width of the bandpass in normalised freq

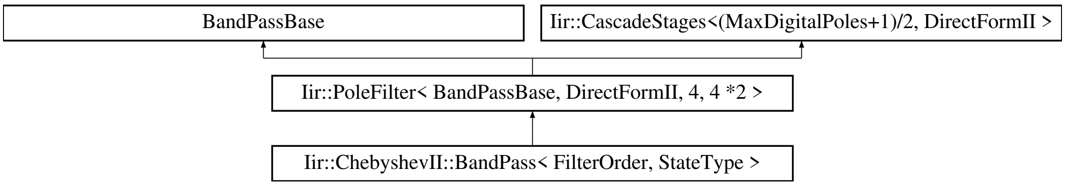
The documentation for this struct was generated from the following file:

- iir/Butterworth.h

6.10 Iir::ChebyshevII::BandPass< FilterOrder, StateType > Struct Template Reference

```
#include <ChebyshevII.h>
```

Inheritance diagram for Iir::ChebyshevII::BandPass< FilterOrder, StateType >:


BandPassBase
Iir::CascadeStages<(MaxDigitalPoles+1)/2, DirectFormII >
Iir::PoleFilter< BandPassBase, DirectFormII, 4, 4 *2 >
Iir::ChebyshevII::BandPass< FilterOrder, StateType >

Public Member Functions

- void setup (double sampleRate, double centerFrequency, double widthFrequency, double stopBandDb)
- void setup (int reqOrder, double sampleRate, double centerFrequency, double widthFrequency, double stopBandDb)
- void setupN (double centerFrequency, double widthFrequency, double stopBandDb)
- void setupN (int reqOrder, double centerFrequency, double widthFrequency, double stopBandDb)

6.10.1 Detailed Description

template<int FilterOrder = 4, class StateType = DirectFormII>
struct Iir::ChebyshevII::BandPass< FilterOrder, StateType >

ChebyshevII bandpass filter

Parameters

FilterOrder	Reserves memory for a filter of the order FilterOrder
StateType	The filter topology: DirectFormI, DirectFormII, ...

6.10.2 Member Function Documentation

6.10.2.1 setup() [1/2]

```
template<int FilterOrder = 4, class StateType = DirectFormII>
void Iir::ChebyshevII::BandPass< FilterOrder, StateType >::setup (
            double sampleRate,
            double centerFrequency,
            double widthFrequency,
            double stopBandDb )  [inline]
```

Calculates the coefficients of the filter

Parameters

sampleRate	Sampling rate
centerFrequency	Center frequency of the bandpass
widthFrequency	Width of the bandpass
stopBandDb	Permitted ripples in dB in the stopband

6.10.2.2 setup() [2/2]

```
template<int FilterOrder = 4, class StateType = DirectFormII>
void Iir::ChebyshevII::BandPass< FilterOrder, StateType >::setup (
            int reqOrder,
            double sampleRate,
            double centerFrequency,
            double widthFrequency,
            double stopBandDb )  [inline]
```

Calculates the coefficients of the filter

Parameters

reqOrder	Requested order which can be less than the instantiated one
sampleRate	Sampling rate
centerFrequency	Center frequency of the bandpass
widthFrequency	Width of the bandpass
stopBandDb	Permitted ripples in dB in the stopband

6.10.2.3 setupN() [1/2] template<int FilterOrder = 4, class StateType = DirectFormII>

```
void Iir::ChebyshevII::BandPass< FilterOrder, StateType >::setupN (
             double centerFrequency,
             double widthFrequency,
             double stopBandDb )  [inline]
```

Calculates the coefficients of the filter

Parameters

centerFrequency	Normalised centre frequency (0..1/2) of the bandpass
widthFrequency	Width of the bandpass
stopBandDb	Permitted ripples in dB in the stopband

6.10.2.4 setupN() [2/2] template<int FilterOrder = 4, class StateType = DirectFormII>

```
void Iir::ChebyshevII::BandPass< FilterOrder, StateType >::setupN (
             int reqOrder,
             double centerFrequency,
             double widthFrequency,
             double stopBandDb )  [inline]
```

Calculates the coefficients of the filter

Parameters

reqOrder	Requested order which can be less than the instantiated one
centerFrequency	Normalised centre frequency (0..1/2) of the bandpass
widthFrequency	Width of the bandpass
stopBandDb	Permitted ripples in dB in the stopband

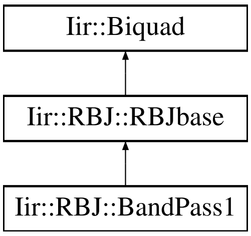
The documentation for this struct was generated from the following file:

- iir/ChebyshevII.h

6.11 Iir::RBJ::BandPass1 Struct Reference

```
#include <RBJ.h>
```

Inheritance diagram for Iir::RBJ::BandPass1:



Public Member Functions

- void setupN (double centerFrequency, double bandWidth)
- void setup (double sampleRate, double centerFrequency, double bandWidth)

6.11.1 Detailed Description

Bandpass with constant skirt gain

6.11.2 Member Function Documentation

6.11.2.1 setup()

```
void Iir::RBJ::BandPass1::setup (
        double sampleRate,
        double centerFrequency,
        double bandWidth )  [inline]
```

Calculates the coefficients

Parameters

sampleRate	Sampling rate
centerFrequency	Center frequency of the bandpass
bandWidth	Bandwidth in octaves

6.11.2.2 setupN()

```
void Iir::RBJ::BandPass1::setupN (
        double centerFrequency,
        double bandWidth )
```

Calculates the coefficients

Parameters

centerFrequency	Center frequency of the bandpass
bandWidth	Bandwidth in octaves

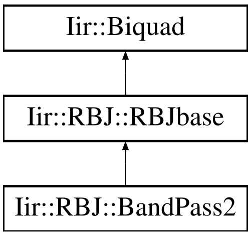
The documentation for this struct was generated from the following files:

- iir/RBJ.h
- iir/RBJ.cpp

6.12 Iir::RBJ::BandPass2 Struct Reference

```
#include <RBJ.h>
```

Inheritance diagram for Iir::RBJ::BandPass2:



Public Member Functions

- void setupN (double centerFrequency, double bandWidth)
- void setup (double sampleRate, double centerFrequency, double bandWidth)

6.12.1 Detailed Description

Bandpass with constant 0 dB peak gain

6.12.2 Member Function Documentation

6.12.2.1 setup()

```
void Iir::RBJ::BandPass2::setup (
        double sampleRate,
        double centerFrequency,
        double bandWidth )  [inline]
```

Calculates the coefficients

Parameters

sampleRate	Sampling rate
centerFrequency	Center frequency of the bandpass
bandWidth	Bandwidth in octaves

6.12.2.2 setupN()

```
void Iir::RBJ::BandPass2::setupN (
        double centerFrequency,
        double bandWidth )
```

Calculates the coefficients

Parameters

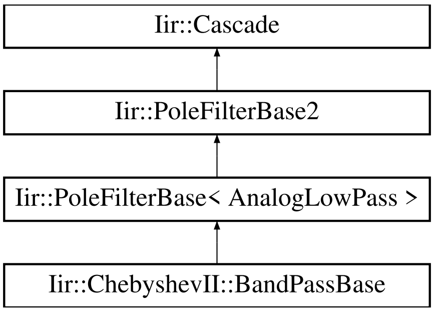
centerFrequency	Normalised centre frequency of the bandpass
bandWidth	Bandwidth in octaves

The documentation for this struct was generated from the following files:

- iir/RBJ.h
- iir/RBJ.cpp

6.13 Iir::ChebyshevII::BandPassBase Struct Reference

Inheritance diagram for Iir::ChebyshevII::BandPassBase:


Iir::Cascade
Iir::PoleFilterBase2
Iir::PoleFilterBase< AnalogLowPass >
Iir::ChebyshevII::BandPassBase

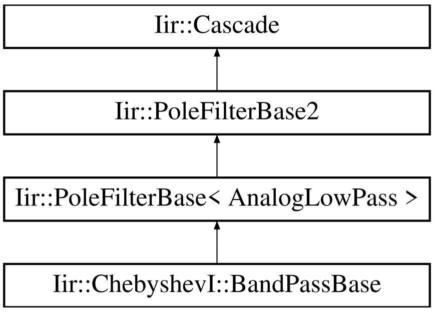
Additional Inherited Members

The documentation for this struct was generated from the following files:

- iir/ChebyshevII.h
- iir/ChebyshevII.cpp

6.14 Iir::ChebyshevI::BandPassBase Struct Reference

Inheritance diagram for Iir::ChebyshevI::BandPassBase:


Iir::Cascade
Iir::PoleFilterBase2
Iir::PoleFilterBase< AnalogLowPass >
Iir::ChebyshevI::BandPassBase

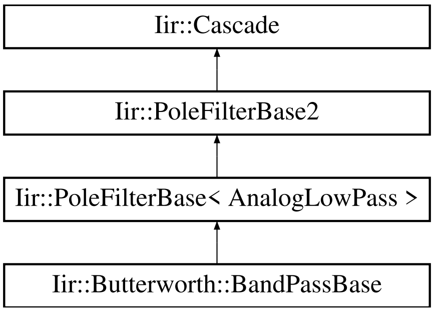
Additional Inherited Members

The documentation for this struct was generated from the following files:

- iir/ChebyshevI.h
- iir/ChebyshevI.cpp

6.15 Iir::Butterworth::BandPassBase Struct Reference

Inheritance diagram for Iir::Butterworth::BandPassBase:


Iir::Cascade
Iir::PoleFilterBase2
Iir::PoleFilterBase< AnalogLowPass >
Iir::Butterworth::BandPassBase

Additional Inherited Members

The documentation for this struct was generated from the following files:

- iir/Butterworth.h
- iir/Butterworth.cpp

6.16 Iir::BandPassTransform Class Reference

```
#include <PoleFilter.h>
```

6.16.1 Detailed Description

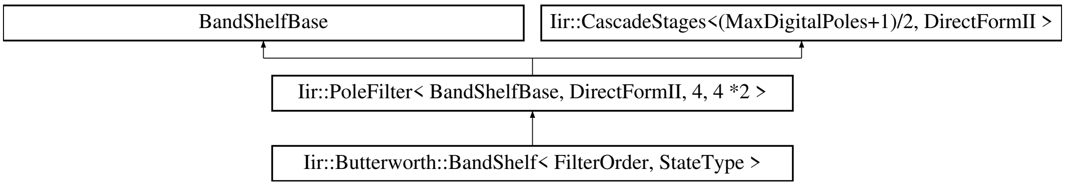
low pass to band pass transform
The documentation for this class was generated from the following files:

- iir/PoleFilter.h
- iir/PoleFilter.cpp

6.17 Iir::Butterworth::BandShelf< FilterOrder, StateType > Struct Template Reference

```
#include <Butterworth.h>
```

Inheritance diagram for Iir::Butterworth::BandShelf< FilterOrder, StateType >:


BandShelfBase
Iir::CascadeStages<(MaxDigitalPoles+1)/2, DirectFormII >
Iir::PoleFilter< BandShelfBase, DirectFormII, 4, 4 *2 >
Iir::Butterworth::BandShelf< FilterOrder, StateType >

Public Member Functions

- void setup (double sampleRate, double centerFrequency, double widthFrequency, double gainDb)
- void setup (int reqOrder, double sampleRate, double centerFrequency, double widthFrequency, double gain↩ Db)
- void setupN (double centerFrequency, double widthFrequency, double gainDb)
- void setupN (int reqOrder, double centerFrequency, double widthFrequency, double gainDb)

6.17.1 Detailed Description

template<int FilterOrder = 4, class StateType = DirectFormII>
struct Iir::Butterworth::BandShelf< FilterOrder, StateType >

Butterworth Bandshelf filter: it is a bandpass filter which amplifies at a specified gain in dB the frequencies in the passband.

Parameters

FilterOrder	Reserves memory for a filter of the order FilterOrder
StateType	The filter topology: DirectFormI, DirectFormII, ...

6.17.2 Member Function Documentation

6.17.2.1 setup() [1/2]

```
template<int FilterOrder = 4, class StateType = DirectFormII>
void Iir::Butterworth::BandShelf< FilterOrder, StateType >::setup (
            double sampleRate,
            double centerFrequency,
            double widthFrequency,
            double gainDb )  [inline]
```

Calculates the coefficients with the filter order provided by the instantiation

Parameters

sampleRate	Sampling rate
centerFrequency	Centre frequency of the passband
widthFrequency	Width of the passband
gainDb	The gain in the passband

6.17.2.2 setup() [2/2]

```
template<int FilterOrder = 4, class StateType = DirectFormII>
void Iir::Butterworth::BandShelf< FilterOrder, StateType >::setup (
            int reqOrder,
            double sampleRate,
            double centerFrequency,
            double widthFrequency,
            double gainDb )  [inline]
```

Calculates the coefficients

Parameters

reqOrder	The actual order which can be less than the instantiated one
sampleRate	Sampling rate
centerFrequency	Centre frequency of the passband
widthFrequency	Width of the passband
gainDb	The gain in the passband

6.17.2.3 setupN() [1/2]

```
template<int FilterOrder = 4, class StateType = DirectFormII>
void Iir::Butterworth::BandShelf< FilterOrder, StateType >::setupN (
            double centerFrequency,
            double widthFrequency,
            double gainDb )  [inline]
```

Calculates the coefficients with the filter order provided by the instantiation

Parameters

centerFrequency	Normalised centre frequency (0..1/2) of the passband
widthFrequency	Width of the passband
gainDb	The gain in the passband

6.17.2.4 setupN() [2/2]

```
template<int FilterOrder = 4, class StateType = DirectFormII>
void Iir::Butterworth::BandShelf< FilterOrder, StateType >::setupN (
            int reqOrder,
            double centerFrequency,
            double widthFrequency,
            double gainDb )  [inline]
```

Calculates the coefficients

Parameters

reqOrder	The actual order which can be less than the instantiated one
centerFrequency	Normalised centre frequency (0..1/2) of the passband
widthFrequency	Width of the passband
gainDb	The gain in the passband

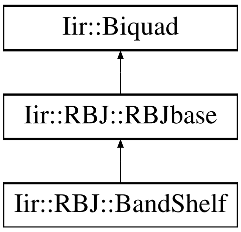
The documentation for this struct was generated from the following file:

- iir/Butterworth.h

6.18 Iir::RBJ::BandShelf Struct Reference

`#include <RBJ.h>`

Inheritance diagram for Iir::RBJ::BandShelf:



Public Member Functions

- void setupN (double centerFrequency, double gainDb, double bandWidth)
- void setup (double sampleRate, double centerFrequency, double gainDb, double bandWidth)

6.18.1 Detailed Description

Band shelf: 0db in the stopband and gainDb in the passband.

6.18.2 Member Function Documentation

6.18.2.1 setup()

```
void Iir::RBJ::BandShelf::setup (
        double sampleRate,
        double centerFrequency,
        double gainDb,
        double bandWidth )  [inline]
```

Calculates the coefficients

Parameters

sampleRate	Sampling rate
centerFrequency	frequency
gainDb	Gain in the passband
bandWidth	Bandwidth in octaves

6.18.2.2 setupN()

```
void Iir::RBJ::BandShelf::setupN (
            double centerFrequency,
            double gainDb,
            double bandWidth )
```

Calculates the coefficients

Parameters

centerFrequency	Normalised centre frequency
gainDb	Gain in the passband
bandWidth	Bandwidth in octaves

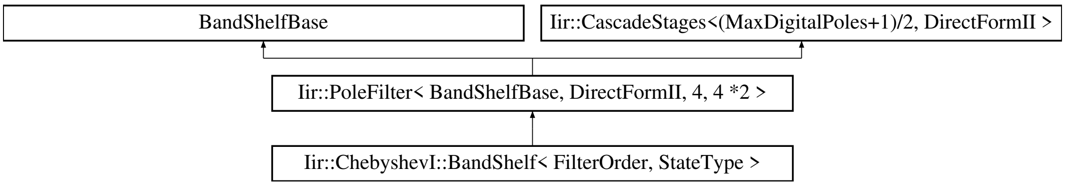
The documentation for this struct was generated from the following files:

- iir/RBJ.h
- iir/RBJ.cpp

6.19 Iir::ChebyshevI::BandShelf< FilterOrder, StateType > Struct Template Reference

```
#include <ChebyshevI.h>
```

Inheritance diagram for Iir::ChebyshevI::BandShelf< FilterOrder, StateType >:


BandShelfBase
Iir::CascadeStages<(MaxDigitalPoles+1)/2, DirectFormII >
Iir::PoleFilter< BandShelfBase, DirectFormII, 4, 4 *2 >
Iir::ChebyshevI::BandShelf< FilterOrder, StateType >

Public Member Functions

- void setup (double sampleRate, double centerFrequency, double widthFrequency, double gainDb, double rippleDb)
- void setup (int reqOrder, double sampleRate, double centerFrequency, double widthFrequency, double gainDb, double rippleDb)
- void setupN (double centerFrequency, double widthFrequency, double gainDb, double rippleDb)
- void setupN (int reqOrder, double centerFrequency, double widthFrequency, double gainDb, double rippleDb)

6.19.1 Detailed Description

template<int FilterOrder = 4, class StateType = DirectFormII>
struct Iir::ChebyshevI::BandShelf< FilterOrder, StateType >

ChebyshevI bandshelf filter. Specified gain in the passband. Otherwise 0 dB.

Parameters

FilterOrder	Reserves memory for a filter of the order FilterOrder
StateType	The filter topology: DirectFormI, DirectFormII, ...

6.19.2 Member Function Documentation

6.19.2.1 setup() [1/2] template<int FilterOrder = 4, class StateType = DirectFormII>

```
void Iir::ChebyshevI::BandShelf< FilterOrder, StateType >::setup (
            double sampleRate,
            double centerFrequency,
            double widthFrequency,
            double gainDb,
            double rippleDb )  [inline]
```

Calculates the coefficients of the filter at the order FilterOrder

Parameters

sampleRate	Sampling rate
centerFrequency	Center frequency of the passband
widthFrequency	Width of the passband.
gainDb	Gain in the passband. The stopband has 0 dB.
rippleDb	Permitted ripples in dB in the passband.

6.19.2.2 setup() [2/2]

```
template<int FilterOrder = 4, class StateType = DirectFormII>
void Iir::ChebyshevI::BandShelf< FilterOrder, StateType >::setup (
             int reqOrder,
             double sampleRate,
             double centerFrequency,
             double widthFrequency,
             double gainDb,
             double rippleDb )  [inline]
```

Calculates the coefficients of the filter at specified order

Parameters

reqOrder	Actual order for the filter calculations
sampleRate	Sampling rate
centerFrequency	Center frequency of the passband
widthFrequency	Width of the passband.
gainDb	Gain in the passband. The stopband has 0 dB.
rippleDb	Permitted ripples in dB in the passband.

6.19.2.3 setupN() [1/2]

```
template<int FilterOrder = 4, class StateType = DirectFormII>
void Iir::ChebyshevI::BandShelf< FilterOrder, StateType >::setupN (
             double centerFrequency,
             double widthFrequency,
             double gainDb,
             double rippleDb )  [inline]
```

Calculates the coefficients of the filter at the order FilterOrder

Parameters

centerFrequency	Normalised centre frequency (0..1/2) of the passband
widthFrequency	Width of the passband.
gainDb	Gain in the passband. The stopband has 0 dB.
rippleDb	Permitted ripples in dB in the passband.

6.19.2.4 setupN() [2/2]

```
template<int FilterOrder = 4, class StateType = DirectFormII>
void Iir::ChebyshevI::BandShelf< FilterOrder, StateType >::setupN (
              int reqOrder,
              double centerFrequency,
              double widthFrequency,
              double gainDb,
              double rippleDb )  [inline]
```

Calculates the coefficients of the filter at specified order

Parameters

reqOrder	Actual order for the filter calculations
centerFrequency	Normalised centre frequency (0..1/2) of the passband
widthFrequency	Width of the passband.
gainDb	Gain in the passband. The stopband has 0 dB.
rippleDb	Permitted ripples in dB in the passband.

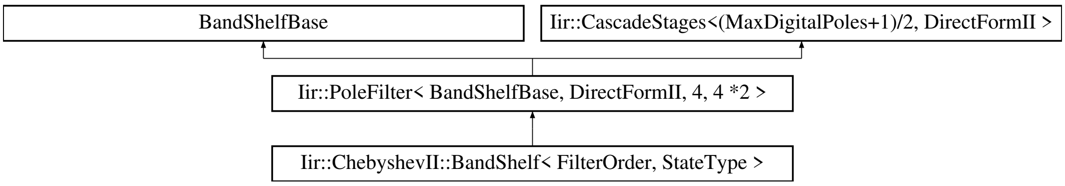
The documentation for this struct was generated from the following file:

- iir/ChebyshevI.h

6.20 Iir::ChebyshevII::BandShelf< FilterOrder, StateType > Struct Template Reference

```
#include <ChebyshevII.h>
```

Inheritance diagram for Iir::ChebyshevII::BandShelf< FilterOrder, StateType >:


BandShelfBase
Iir::CascadeStages<(MaxDigitalPoles+1)/2, DirectFormII >
Iir::PoleFilter< BandShelfBase, DirectFormII, 4, 4 *2 >
Iir::ChebyshevII::BandShelf< FilterOrder, StateType >

Public Member Functions

- void setup (double sampleRate, double centerFrequency, double widthFrequency, double gainDb, double stopBandDb)
- void setup (int reqOrder, double sampleRate, double centerFrequency, double widthFrequency, double gainDb, double stopBandDb)
- void setupN (double centerFrequency, double widthFrequency, double gainDb, double stopBandDb)
- void setupN (int reqOrder, double centerFrequency, double widthFrequency, double gainDb, double stopBandDb)

6.20.1 Detailed Description

template<int FilterOrder = 4, class StateType = DirectFormII>
struct Iir::ChebyshevII::BandShelf< FilterOrder, StateType >

ChebyshevII bandshelf filter. Bandpass with specified gain and 0 dB gain in the stopband.

Parameters

FilterOrder	Reserves memory for a filter of the order FilterOrder
StateType	The filter topology: DirectFormI, DirectFormII, ...

6.20.2 Member Function Documentation

6.20.2.1 setup() [1/2]

```
template<int FilterOrder = 4, class StateType = DirectFormII>
void Iir::ChebyshevII::BandShelf< FilterOrder, StateType >::setup (
            double sampleRate,
            double centerFrequency,
            double widthFrequency,
            double gainDb,
            double stopBandDb )  [inline]
```

Calculates the coefficients of the filter

Parameters

sampleRate	Sampling rate
centerFrequency	Center frequency of the bandpass
widthFrequency	Width of the bandpass
gainDb	Gain in the passband. The stopband has always 0dB.
stopBandDb	Permitted ripples in dB in the stopband

6.20.2.2 setup() [2/2]

```
template<int FilterOrder = 4, class StateType = DirectFormII>
void Iir::ChebyshevII::BandShelf< FilterOrder, StateType >::setup (
            int reqOrder,
            double sampleRate,
            double centerFrequency,
            double widthFrequency,
            double gainDb,
            double stopBandDb )  [inline]
```

Calculates the coefficients of the filter

Parameters

reqOrder	Requested order which can be less than the instantiated one
sampleRate	Sampling rate
centerFrequency	Center frequency of the bandpass
widthFrequency	Width of the bandpass
gainDb	Gain in the passband. The stopband has always 0dB.
stopBandDb	Permitted ripples in dB in the stopband

6.20.2.3 setupN() [1/2]

```
template<int FilterOrder = 4, class StateType = DirectFormII>
void Iir::ChebyshevII::BandShelf< FilterOrder, StateType >::setupN (
            double centerFrequency,
            double widthFrequency,
            double gainDb,
            double stopBandDb )  [inline]
```

Calculates the coefficients of the filter

Parameters

centerFrequency	Normalised centre frequency (0..1/2) of the bandpass
widthFrequency	Width of the bandpass

Parameters

gainDb	Gain in the passband. The stopband has always 0dB.
stopBandDb	Permitted ripples in dB in the stopband

6.20.2.4 setupN() [2/2]

```
template<int FilterOrder = 4, class StateType = DirectFormII>
void Iir::ChebyshevII::BandShelf< FilterOrder, StateType >::setupN (
            int reqOrder,
            double centerFrequency,
            double widthFrequency,
            double gainDb,
            double stopBandDb )  [inline]
```

Calculates the coefficients of the filter

Parameters

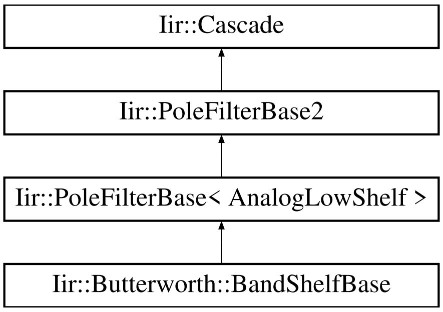
reqOrder	Requested order which can be less than the instantiated one
centerFrequency	Normalised centre frequency (0..1/2) of the bandpass
widthFrequency	Width of the bandpass
gainDb	Gain in the passband. The stopband has always 0dB.
stopBandDb	Permitted ripples in dB in the stopband

The documentation for this struct was generated from the following file:

- iir/ChebyshevII.h

6.21 Iir::Butterworth::BandShelfBase Struct Reference

Inheritance diagram for Iir::Butterworth::BandShelfBase:


Iir::Cascade
Iir::PoleFilterBase2
Iir::PoleFilterBase< AnalogLowShelf >
Iir::Butterworth::BandShelfBase

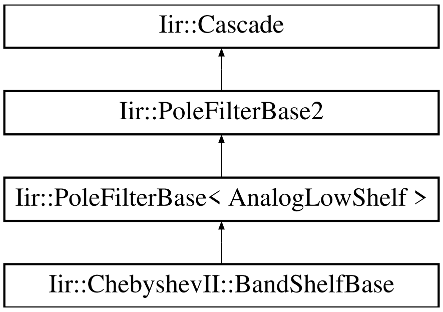
Additional Inherited Members

The documentation for this struct was generated from the following files:

- iir/Butterworth.h
- iir/Butterworth.cpp

6.22 Iir::ChebyshevII::BandShelfBase Struct Reference

Inheritance diagram for Iir::ChebyshevII::BandShelfBase:


Iir::Cascade
Iir::PoleFilterBase2
Iir::PoleFilterBase< AnalogLowShelf >
Iir::ChebyshevII::BandShelfBase

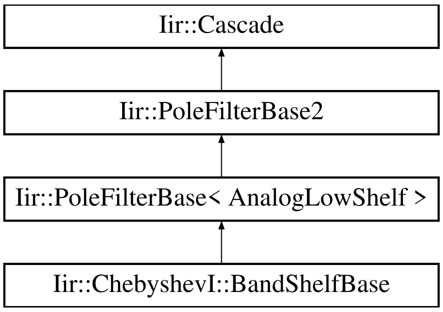
Additional Inherited Members

The documentation for this struct was generated from the following files:

- iir/ChebyshevII.h
- iir/ChebyshevII.cpp

6.23 Iir::ChebyshevI::BandShelfBase Struct Reference

Inheritance diagram for Iir::ChebyshevI::BandShelfBase:


Iir::Cascade
Iir::PoleFilterBase2
Iir::PoleFilterBase< AnalogLowShelf >
Iir::ChebyshevI::BandShelfBase

Additional Inherited Members

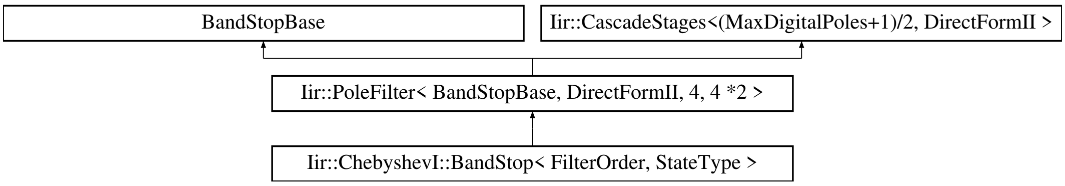
The documentation for this struct was generated from the following files:

- iir/ChebyshevI.h
- iir/ChebyshevI.cpp

6.24 Iir::ChebyshevI::BandStop< FilterOrder, StateType > Struct Template Reference

`#include <ChebyshevI.h>`

Inheritance diagram for Iir::ChebyshevI::BandStop< FilterOrder, StateType >:


BandStopBase
Iir::CascadeStages<(MaxDigitalPoles+1)/2, DirectFormII >
Iir::PoleFilter< BandStopBase, DirectFormII, 4, 4 *2 >
Iir::ChebyshevI::BandStop< FilterOrder, StateType >

Public Member Functions

- void setup (double sampleRate, double centerFrequency, double widthFrequency, double rippleDb)
- void setup (int reqOrder, double sampleRate, double centerFrequency, double widthFrequency, double rippleDb)
- void setupN (double centerFrequency, double widthFrequency, double rippleDb)
- void setupN (int reqOrder, double centerFrequency, double widthFrequency, double rippleDb)

6.24.1 Detailed Description

template<int FilterOrder = 4, class StateType = DirectFormII>
struct Iir::ChebyshevI::BandStop< FilterOrder, StateType >

ChebyshevI bandstop filter

Parameters

FilterOrder	Reserves memory for a filter of the order FilterOrder
StateType	The filter topology: DirectFormI, DirectFormII, ...

6.24.2 Member Function Documentation

6.24.2.1 setup() [1/2]

```
template<int FilterOrder = 4, class StateType = DirectFormII>
void Iir::ChebyshevI::BandStop< FilterOrder, StateType >::setup (
            double sampleRate,
            double centerFrequency,
            double widthFrequency,
            double rippleDb )  [inline]
```

Calculates the coefficients of the filter at the order FilterOrder

Parameters

sampleRate	Sampling rate
centerFrequency	Center frequency of the notch
widthFrequency	Frequency with of the notch
rippleDb	Permitted ripples in dB in the passband

6.24.2.2 setup() [2/2]

```
template<int FilterOrder = 4, class StateType = DirectFormII>
void Iir::ChebyshevI::BandStop< FilterOrder, StateType >::setup (
            int reqOrder,
            double sampleRate,
            double centerFrequency,
            double widthFrequency,
            double rippleDb )  [inline]
```

Calculates the coefficients of the filter at specified order

Parameters

reqOrder	Actual order for the filter calculations
sampleRate	Sampling rate
centerFrequency	Center frequency of the notch
widthFrequency	Frequency with of the notch
rippleDb	Permitted ripples in dB in the passband

6.24.2.3 setupN() [1/2]

```
template<int FilterOrder = 4, class StateType = DirectFormII>
void Iir::ChebyshevI::BandStop< FilterOrder, StateType >::setupN (
            double centerFrequency,
            double widthFrequency,
            double rippleDb )  [inline]
```

Calculates the coefficients of the filter at the order FilterOrder

Parameters

centerFrequency	Normalised centre frequency (0..1/2) of the notch
widthFrequency	Frequency width of the notch
rippleDb	Permitted ripples in dB in the passband

6.24.2.4 setupN() [2/2]

```
template<int FilterOrder = 4, class StateType = DirectFormII>
void Iir::ChebyshevI::BandStop< FilterOrder, StateType >::setupN (
            int reqOrder,
            double centerFrequency,
            double widthFrequency,
            double rippleDb )  [inline]
```

Calculates the coefficients of the filter at specified order

Parameters

reqOrder	Actual order for the filter calculations
centerFrequency	Normalised centre frequency (0..1/2) of the notch
widthFrequency	Frequency width of the notch
rippleDb	Permitted ripples in dB in the passband

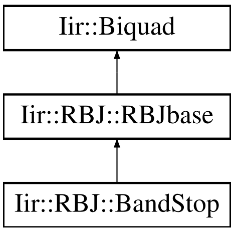
The documentation for this struct was generated from the following file:

- iir/ChebyshevI.h

6.25 Iir::RBJ::BandStop Struct Reference

```
#include <RBJ.h>
```

Inheritance diagram for Iir::RBJ::BandStop:



Public Member Functions

- void setupN (double centerFrequency, double bandWidth)
- void setup (double sampleRate, double centerFrequency, double bandWidth)

6.25.1 Detailed Description

Bandstop filter. Warning: the bandwidth might not be accurate for narrow notches.

6.25.2 Member Function Documentation

6.25.2.1 setup()

```
void Iir::RBJ::BandStop::setup (
        double sampleRate,
        double centerFrequency,
        double bandWidth )  [inline]
```

Calculates the coefficients

Parameters

sampleRate	Sampling rate
centerFrequency	Center frequency of the bandstop
bandWidth	Bandwidth in octaves

6.25.2.2 setupN()

```
void Iir::RBJ::BandStop::setupN (
        double centerFrequency,
        double bandWidth )
```

Calculates the coefficients

Parameters

centerFrequency	Normalised Centre frequency of the bandstop
bandWidth	Bandwidth in octaves

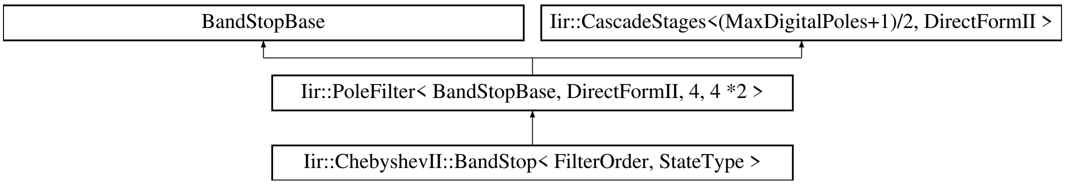
The documentation for this struct was generated from the following files:

- iir/RBJ.h
- iir/RBJ.cpp

6.26 Iir::ChebyshevII::BandStop< FilterOrder, StateType > Struct Template Reference

`#include <ChebyshevII.h>`

Inheritance diagram for Iir::ChebyshevII::BandStop< FilterOrder, StateType >:


BandStopBase
Iir::CascadeStages<(MaxDigitalPoles+1)/2, DirectFormII >
Iir::PoleFilter< BandStopBase, DirectFormII, 4, 4 *2 >
Iir::ChebyshevII::BandStop< FilterOrder, StateType >

Public Member Functions

- void setup (double sampleRate, double centerFrequency, double widthFrequency, double stopBandDb)
- void setup (int reqOrder, double sampleRate, double centerFrequency, double widthFrequency, double stopBandDb)
- void setupN (double centerFrequency, double widthFrequency, double stopBandDb)
- void setupN (int reqOrder, double centerFrequency, double widthFrequency, double stopBandDb)

6.26.1 Detailed Description

template<int FilterOrder = 4, class StateType = DirectFormII>
struct Iir::ChebyshevII::BandStop< FilterOrder, StateType >

ChebyshevII bandstop filter.

Parameters

FilterOrder	Reserves memory for a filter of the order FilterOrder
StateType	The filter topology: DirectFormI, DirectFormII, ...

6.26.2 Member Function Documentation

6.26.2.1 setup() [1/2]

```
template<int FilterOrder = 4, class StateType = DirectFormII>
void Iir::ChebyshevII::BandStop< FilterOrder, StateType >::setup (
            double sampleRate,
            double centerFrequency,
            double widthFrequency,
            double stopBandDb )  [inline]
```

Calculates the coefficients of the filter

Parameters

sampleRate	Sampling rate
centerFrequency	Center frequency of the bandstop
widthFrequency	Width of the bandstop
stopBandDb	Permitted ripples in dB in the stopband

6.26.2.2 setup() [2/2]

```
template<int FilterOrder = 4, class StateType = DirectFormII>
void Iir::ChebyshevII::BandStop< FilterOrder, StateType >::setup (
            int reqOrder,
            double sampleRate,
            double centerFrequency,
            double widthFrequency,
            double stopBandDb )  [inline]
```

Calculates the coefficients of the filter

Parameters

reqOrder	Requested order which can be less than the instantiated one
sampleRate	Sampling rate
centerFrequency	Center frequency of the bandstop
widthFrequency	Width of the bandstop
stopBandDb	Permitted ripples in dB in the stopband

6.26.2.3 setupN() [1/2]

```
template<int FilterOrder = 4, class StateType = DirectFormII>
void Iir::ChebyshevII::BandStop< FilterOrder, StateType >::setupN (
            double centerFrequency,
            double widthFrequency,
            double stopBandDb )  [inline]
```

Calculates the coefficients of the filter

Parameters

centerFrequency	Normalised centre frequency (0..1/2) of the bandstop

Parameters

widthFrequency	Width of the bandstop
stopBandDb	Permitted ripples in dB in the stopband

6.26.2.4 setupN() [2/2]

```
template<int FilterOrder = 4, class StateType = DirectFormII>
void Iir::ChebyshevII::BandStop< FilterOrder, StateType >::setupN (
            int reqOrder,
            double centerFrequency,
            double widthFrequency,
            double stopBandDb )  [inline]
```

Calculates the coefficients of the filter

Parameters

reqOrder	Requested order which can be less than the instantiated one
centerFrequency	Normalised centre frequency (0..1/2) of the bandstop
widthFrequency	Width of the bandstop
stopBandDb	Permitted ripples in dB in the stopband

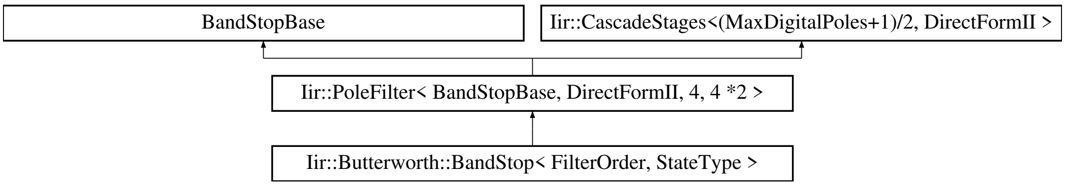
The documentation for this struct was generated from the following file:

- iir/ChebyshevII.h

6.27 Iir::Butterworth::BandStop< FilterOrder, StateType > Struct Template Reference

`#include <Butterworth.h>`

Inheritance diagram for Iir::Butterworth::BandStop< FilterOrder, StateType >:


BandStopBase
Iir::CascadeStages<(MaxDigitalPoles+1)/2, DirectFormII >
Iir::PoleFilter< BandStopBase, DirectFormII, 4, 4 *2 >
Iir::Butterworth::BandStop< FilterOrder, StateType >

Public Member Functions

- void setup (double sampleRate, double centerFrequency, double widthFrequency)
- void setupN (int reqOrder, double sampleRate, double centerFrequency, double widthFrequency)
- void setupN (double centerFrequency, double widthFrequency)
- void setupN (int reqOrder, double centerFrequency, double widthFrequency)

6.27.1 Detailed Description

template<int FilterOrder = 4, class StateType = DirectFormII>
struct Iir::Butterworth::BandStop< FilterOrder, StateType >

Butterworth Bandstop filter.

Parameters

FilterOrder	Reserves memory for a filter of the order FilterOrder
StateType	The filter topology: DirectFormI, DirectFormII, ...

6.27.2 Member Function Documentation

6.27.2.1 setup() template<int FilterOrder = 4, class StateType = DirectFormII>

```
void Iir::Butterworth::BandStop< FilterOrder, StateType >::setup (
            double sampleRate,
            double centerFrequency,
            double widthFrequency )  [inline]
```

Calculates the coefficients with the filter order provided by the instantiation

Parameters

sampleRate	Sampling rate
centerFrequency	Centre frequency of the bandstop
widthFrequency	Width of the bandstop

6.27.2.2 setupN() [1/3] template<int FilterOrder = 4, class StateType = DirectFormII>

```
void Iir::Butterworth::BandStop< FilterOrder, StateType >::setupN (
            double centerFrequency,
            double widthFrequency )  [inline]
```

Calculates the coefficients with the filter order provided by the instantiation

Parameters

centerFrequency	Normalised centre frequency (0..1/2) of the bandstop
widthFrequency	Normalised width of the bandstop

6.27.2.3 setupN() [2/3] template<int FilterOrder = 4, class StateType = DirectFormII>

```
void Iir::Butterworth::BandStop< FilterOrder, StateType >::setupN (
            int reqOrder,
            double centerFrequency,
            double widthFrequency )  [inline]
```

Calculates the coefficients

Parameters

reqOrder	The actual order which can be less than the instantiated one
centerFrequency	Normalised centre frequency (0..1/2) of the bandstop
widthFrequency	Normalised width of the bandstop

6.27.2.4 setupN() [3/3] template<int FilterOrder = 4, class StateType = DirectFormII>

```
void Iir::Butterworth::BandStop< FilterOrder, StateType >::setupN (
            int reqOrder,
            double sampleRate,
            double centerFrequency,
            double widthFrequency )  [inline]
```

Calculates the coefficients

Parameters

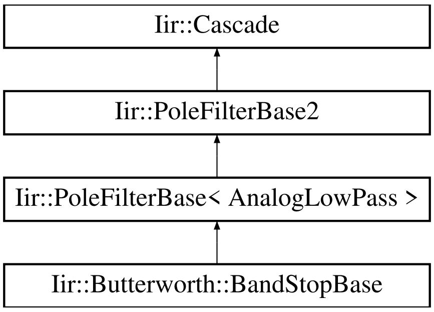
reqOrder	The actual order which can be less than the instantiated one
sampleRate	Sampling rate
centerFrequency	Centre frequency of the bandstop
widthFrequency	Width of the bandstop

The documentation for this struct was generated from the following file:

- iir/Butterworth.h

6.28 Iir::Butterworth::BandStopBase Struct Reference

Inheritance diagram for Iir::Butterworth::BandStopBase:


Iir::Cascade
Iir::PoleFilterBase2
Iir::PoleFilterBase< AnalogLowPass >
Iir::Butterworth::BandStopBase

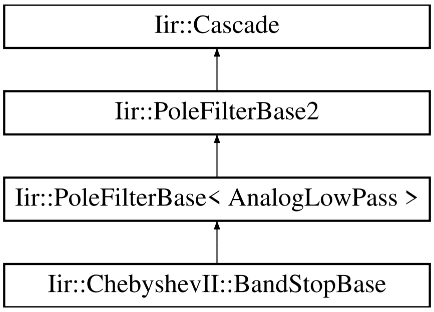
Additional Inherited Members

The documentation for this struct was generated from the following files:

- iir/Butterworth.h
- iir/Butterworth.cpp

6.29 Iir::ChebyshevII::BandStopBase Struct Reference

Inheritance diagram for Iir::ChebyshevII::BandStopBase:


Iir::Cascade
Iir::PoleFilterBase2
Iir::PoleFilterBase< AnalogLowPass >
Iir::ChebyshevII::BandStopBase

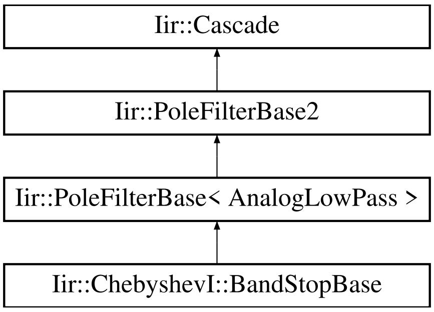
Additional Inherited Members

The documentation for this struct was generated from the following files:

- iir/ChebyshevII.h
- iir/ChebyshevII.cpp

6.30 Iir::ChebyshevI::BandStopBase Struct Reference

Inheritance diagram for Iir::ChebyshevI::BandStopBase:


Iir::Cascade
Iir::PoleFilterBase2
Iir::PoleFilterBase< AnalogLowPass >
Iir::ChebyshevI::BandStopBase

Additional Inherited Members

The documentation for this struct was generated from the following files:

- iir/ChebyshevI.h
- iir/ChebyshevI.cpp

6.31 Iir::BandStopTransform Class Reference

```
#include <PoleFilter.h>
```

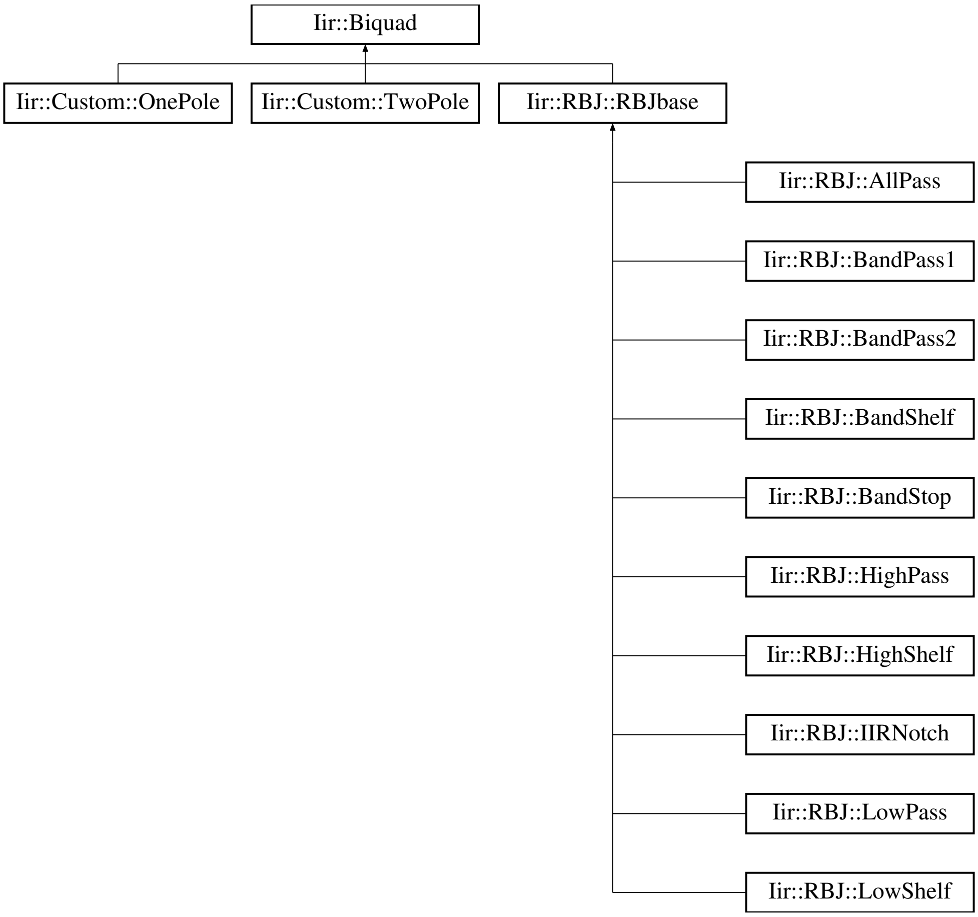
6.31.1 Detailed Description

low pass to band stop transform
The documentation for this class was generated from the following files:

- iir/PoleFilter.h
- iir/PoleFilter.cpp

6.32 Iir::Biquad Class Reference

Inheritance diagram for Iir::Biquad:



Public Member Functions

- complex_t response (double normalizedFrequency) const
- std::vector< PoleZeroPair > getPoleZeros () const
- double getA0 () const
- double getA1 () const
- double getA2 () const
- double getB0 () const
- double getB1 () const
- double getB2 () const
- template<class StateType >
  double filter (double s, StateType &state) const
- void setCoefficients (double a0, double a1, double a2, double b0, double b1, double b2)
- void setOnePole (complex_t pole, complex_t zero)
- void setTwoPole (complex_t pole1, complex_t zero1, complex_t pole2, complex_t zero2)
- void setPoleZeroPair (const PoleZeroPair &pair)
- void setIdentity ()
- void applyScale (double scale)

6.32.1 Member Function Documentation

6.32.1.1 applyScale() `void Iir::Biquad::applyScale ( double scale )`

Performs scaling operation on the FIR coefficients

Parameters

scale	Mulitplies the coefficients b0,b1,b2 with the scaling factor scale.

6.32.1.2 filter() `template<class StateType >`

```
double Iir::Biquad::filter (
            double s,
            StateType & state ) const  [inline]
```

Filter a sample with the coefficients provided here and the State provided as an argument.

Parameters

s	The sample to be filtered.
state	The Delay lines (instance of a state from State.h)

Returns

The filtered sample.

6.32.1.3 getA0() `double Iir::Biquad::getA0 ( ) const [inline]`

Returns 1st IIR coefficient (usually one)

6.32.1.4 getA1() `double Iir::Biquad::getA1 ( ) const [inline]`

Returns 2nd IIR coefficient

6.32.1.5 getA2() `double Iir::Biquad::getA2 ( ) const [inline]`

Returns 3rd IIR coefficient

6.32.1.6 getB0() `double Iir::Biquad::getB0 ( ) const [inline]`

Returns 1st FIR coefficient

6.32.1.7 getB1() `double Iir::Biquad::getB1 ( ) const [inline]`

Returns 2nd FIR coefficient

6.32.1.8 getB2() `double Iir::Biquad::getB2 ( ) const [inline]`

Returns 3rd FIR coefficient

6.32.1.9 getPoleZeros() `std::vector< PoleZeroPair > Iir::Biquad::getPoleZeros ( ) const`

Returns the pole / zero Pairs as a vector.

6.32.1.10 response() `complex_t Iir::Biquad::response (`

```
            double normalizedFrequency ) const
```

Calculate filter response at the given normalized frequency and return the complex response.

Gets the frequency response of the Biquad

Parameters

normalizedFrequency	Normalised frequency (0 to 0.5)

6.32.1.11 setCoefficients()

```
void Iir::Biquad::setCoefficients (
        double a0,
        double a1,
        double a2,
        double b0,
        double b1,
        double b2 )
```

Sets all coefficients

Parameters

a0	1st IIR coefficient
a1	2nd IIR coefficient
a2	3rd IIR coefficient
b0	1st FIR coefficient
b1	2nd FIR coefficient
b2	3rd FIR coefficient

6.32.1.12 setIdentity()

```
void Iir::Biquad::setIdentity ( )
```

Sets the coefficiens as pass through. (b0=1,a0=1, rest zero)

6.32.1.13 setOnePole()

```
void Iir::Biquad::setOnePole (
        complex_t pole,
        complex_t zero )
```

Sets one (real) pole and zero. Throws exception if imaginary components.

6.32.1.14 setPoleZeroPair()

```
void Iir::Biquad::setPoleZeroPair (
        const PoleZeroPair & pair ) [inline]
```

Sets a complex conjugate pair

6.32.1.15 setTwoPole()

```
void Iir::Biquad::setTwoPole (
        complex_t pole1,
        complex_t zero1,
        complex_t pole2,
        complex_t zero2 )
```

Sets two poles/zoes as a pair. Needs to be complex conjugate.

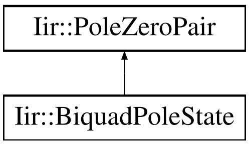
The documentation for this class was generated from the following files:

- iir/Biquad.h
- iir/Biquad.cpp

6.33 Iir::BiquadPoleState Struct Reference

```
#include <Biquad.h>
```

Inheritance diagram for Iir::BiquadPoleState:



6.33.1 Detailed Description

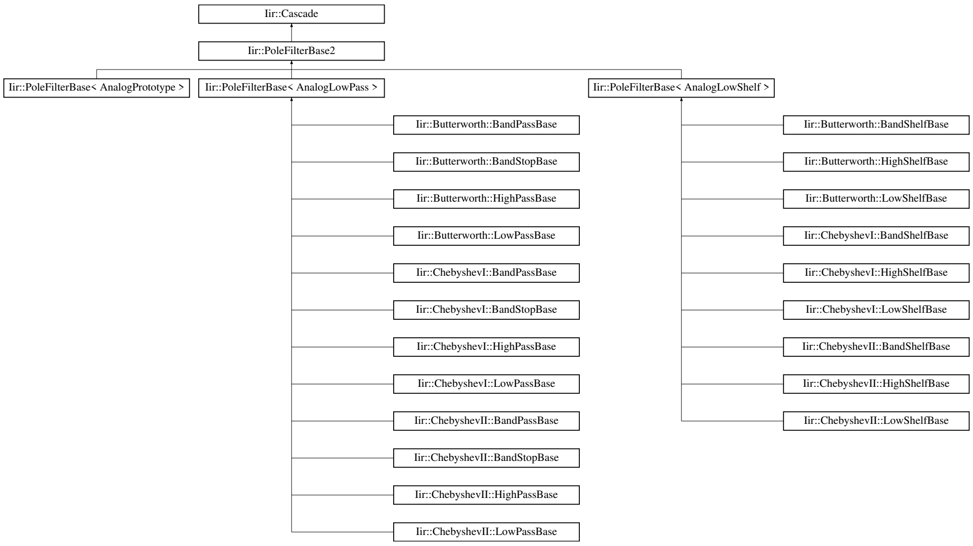
Expresses a biquad as a pair of pole/zeros, with gain values so that the coefficients can be reconstructed precisely.
The documentation for this struct was generated from the following files:

- iir/Biquad.h
- iir/Biquad.cpp

6.34 Iir::Cascade Class Reference

`#include <Cascade.h>`

Inheritance diagram for Iir::Cascade:


Iir::Cascade
Iir::PoleFilterBase2
Iir::PoleFilterBase< AnalogPrototype >
Iir::PoleFilterBase< AnalogLowPass >
Iir::PoleFilterBase< AnalogLowShelf >
Iir::Butterworth::BandPassBase
Iir::Butterworth::BandStopBase
Iir::Butterworth::HighPassBase
Iir::Butterworth::LowPassBase
Iir::ChebyshevI::BandPassBase
Iir::ChebyshevI::BandStopBase
Iir::ChebyshevI::HighPassBase
Iir::ChebyshevI::LowPassBase
Iir::ChebyshevII::BandPassBase
Iir::ChebyshevII::BandStopBase
Iir::ChebyshevII::HighPassBase
Iir::ChebyshevII::LowPassBase
Iir::Butterworth::BandShelfBase
Iir::Butterworth::HighShelfBase
Iir::Butterworth::LowShelfBase
Iir::ChebyshevI::BandShelfBase
Iir::ChebyshevI::HighShelfBase
Iir::ChebyshevI::LowShelfBase
Iir::ChebyshevII::BandShelfBase
Iir::ChebyshevII::HighShelfBase
Iir::ChebyshevII::LowShelfBase

Classes

- struct Storage

Public Member Functions

- int getNumStages () const
- const Biquad & operator[ ] (int index)
- complex_t response (double normalizedFrequency) const
- std::vector< PoleZeroPair > getPoleZeros () const

6.34.1 Detailed Description

Holds coefficients for a cascade of second order sections.

6.34.2 Member Function Documentation

6.34.2.1 getNumStages() `int Iir::Cascade::getNumStages ( ) const [inline]`

Returns the number of Biquads kept here

6.34.2.2 getPoleZeros() `std::vector< PoleZeroPair > Iir::Cascade::getPoleZeros ( ) const`

Returns a vector with all pole/zero pairs of the whole Biqad cascade

6.34.2.3 operator[]()

```
const Biquad& Iir::Cascade::operator[ ] (
            int index ) [inline]
```

Returns a reference to a biquad

6.34.2.4 response() `complex_t Iir::Cascade::response ( double normalizedFrequency ) const`

Calculate filter response at the given normalized frequency

Parameters

normalizedFrequency	Frequency from 0 to 0.5 (Nyquist)

The documentation for this class was generated from the following files:

- iir/Cascade.h
- iir/Cascade.cpp

6.35 Iir::CascadeStages< MaxStages, StateType > Class Template Reference

```
#include <Cascade.h>
```

Public Member Functions

- void reset ()
- void setup (const double(&sosCoefficients)[MaxStages][6])
- template<typename Sample >
  Sample filter (const Sample in)
- const Cascade::Storage getCascadeStorage ()
- const StateType(& getCascadeState ())[MaxStages]

6.35.1 Detailed Description

template<int MaxStages, class StateType>
class Iir::CascadeStages< MaxStages, StateType >

Storage for Cascade: This holds a chain of 2nd order filters with its coefficients.

6.35.2 Member Function Documentation

6.35.2.1 filter() `template<int MaxStages, class StateType >`

```
template<typename Sample >
Sample Iir::CascadeStages< MaxStages, StateType >::filter (
            const Sample in )  [inline]
```

Filters one sample through the whole chain of biquads and return the result

Parameters

in	Sample to be filtered

Returns

filtered sample

6.35.2.2 getCascadeState() `template<int MaxStages, class StateType >`

```
const StateType(& Iir::CascadeStages< MaxStages, StateType >::getCascadeState ( ))[MaxStages]
[inline]
```

Returns the current state of the entire Biquad chain

6.35.2.3 getCascadeStorage() `template<int MaxStages, class StateType >`

```
const Cascade::Storage Iir::CascadeStages< MaxStages, StateType >::getCascadeStorage ( )
[inline]
```

Returns the coefficients of the entire Biquad chain

6.35.2.4 reset() `template<int MaxStages, class StateType >`

```
void Iir::CascadeStages< MaxStages, StateType >::reset ( ) [inline]
```

Resets all biquads (i.e. the delay lines but not the coefficients)

6.35.2.5 setup() `template<int MaxStages, class StateType >`

```
void Iir::CascadeStages< MaxStages, StateType >::setup (
            const double(&) sosCoefficients[MaxStages][6] ) [inline]
```

Sets the coefficients of the whole chain of biquads.

Parameters

sosCoefficients	2D array in Python style sos ordering: 0-2: FIR, 3-5: IIR coeff.

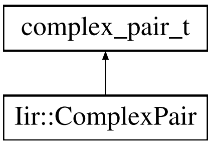
The documentation for this class was generated from the following file:

- iir/Cascade.h

6.36 Iir::ComplexPair Struct Reference

`#include <Types.h>`

Inheritance diagram for Iir::ComplexPair:



Public Member Functions

- bool isMatchedPair () const

6.36.1 Detailed Description

A conjugate or real pair

6.36.2 Member Function Documentation

6.36.2.1 isMatchedPair() `bool Iir::ComplexPair::isMatchedPair ( ) const [inline]`

Returns true if this is either a conjugate pair, or a pair of reals where neither is zero.

The documentation for this struct was generated from the following file:

- iir/Types.h

6.37 Iir::DirectFormI Class Reference

`#include <State.h>`

6.37.1 Detailed Description

State for applying a second order section to a sample using Direct Form I
Difference equation:
y[n] = (b0/a0)∗x[n] + (b1/a0)∗x[n-1] + (b2/a0)∗x[n-2]

- (a1/a0)∗y[n-1] - (a2/a0)∗y[n-2]

The documentation for this class was generated from the following file:

- iir/State.h

6.38 Iir::DirectFormII Class Reference

```
#include <State.h>
```

6.38.1 Detailed Description

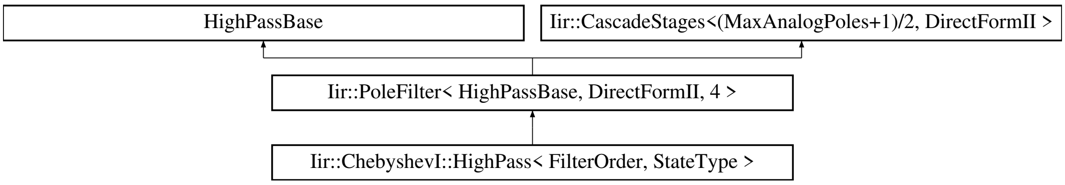
State for applying a second order section to a sample using Direct Form II
Difference equation:
v[n] = x[n] - (a1/a0)∗v[n-1] - (a2/a0)∗v[n-2] y(n) = (b0/a0)∗v[n] + (b1/a0)∗v[n-1] + (b2/a0)∗v[n-2]
The documentation for this class was generated from the following file:

- iir/State.h

6.39 Iir::ChebyshevI::HighPass< FilterOrder, StateType > Struct Template Reference

```
#include <ChebyshevI.h>
```

Inheritance diagram for Iir::ChebyshevI::HighPass< FilterOrder, StateType >:


HighPassBase
Iir::CascadeStages<(MaxAnalogPoles+1)/2, DirectFormII >
Iir::PoleFilter< HighPassBase, DirectFormII, 4 >
Iir::ChebyshevI::HighPass< FilterOrder, StateType >

Public Member Functions

- void setup (double sampleRate, double cutoffFrequency, double rippleDb)
- void setup (int reqOrder, double sampleRate, double cutoffFrequency, double rippleDb)
- void setupN (double cutoffFrequency, double rippleDb)
- void setupN (int reqOrder, double cutoffFrequency, double rippleDb)

6.39.1 Detailed Description

template<int FilterOrder = 4, class StateType = DirectFormII>
struct Iir::ChebyshevI::HighPass< FilterOrder, StateType >

ChebyshevI highpass filter

Parameters

FilterOrder	Reserves memory for a filter of the order FilterOrder
StateType	The filter topology: DirectFormI, DirectFormII, ...

6.39.2 Member Function Documentation

6.39.2.1 setup() [1/2]

```
template<int FilterOrder = 4, class StateType = DirectFormII>
void Iir::ChebyshevI::HighPass< FilterOrder, StateType >::setup (
            double sampleRate,
            double cutoffFrequency,
            double rippleDb )  [inline]
```

Calculates the coefficients of the filter at the order FilterOrder

Parameters

sampleRate	Sampling rate
cutoffFrequency	Cutoff frequency.
rippleDb	Permitted ripples in dB in the passband

6.39.2.2 setup() [2/2]

```
template<int FilterOrder = 4, class StateType = DirectFormII>
void Iir::ChebyshevI::HighPass< FilterOrder, StateType >::setup (
            int reqOrder,
            double sampleRate,
            double cutoffFrequency,
            double rippleDb )  [inline]
```

Calculates the coefficients of the filter at specified order

Parameters

reqOrder	Actual order for the filter calculations
sampleRate	Sampling rate
cutoffFrequency	Cutoff frequency.
rippleDb	Permitted ripples in dB in the passband

6.39.2.3 setupN() [1/2]

```
template<int FilterOrder = 4, class StateType = DirectFormII>
void Iir::ChebyshevI::HighPass< FilterOrder, StateType >::setupN (
            double cutoffFrequency,
            double rippleDb )  [inline]
```

Calculates the coefficients of the filter at the order FilterOrder

Parameters

cutoffFrequency	Normalised cutoff frequency (0..1/2)
rippleDb	Permitted ripples in dB in the passband

6.39.2.4 setupN() [2/2]

```
template<int FilterOrder = 4, class StateType = DirectFormII>
void Iir::ChebyshevI::HighPass< FilterOrder, StateType >::setupN (
            int reqOrder,
            double cutoffFrequency,
            double rippleDb )  [inline]
```

Calculates the coefficients of the filter at specified order

Parameters

reqOrder	Actual order for the filter calculations
cutoffFrequency	Normalised cutoff frequency (0..1/2)
rippleDb	Permitted ripples in dB in the passband

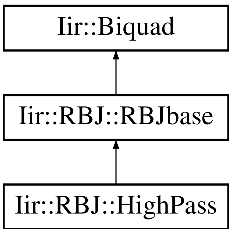
The documentation for this struct was generated from the following file:

- iir/ChebyshevI.h

6.40 Iir::RBJ::HighPass Struct Reference

```
#include <RBJ.h>
```

Inheritance diagram for Iir::RBJ::HighPass:



Public Member Functions

- void setupN (double cutoffFrequency, double q=(1/sqrt(2)))
- void setup (double sampleRate, double cutoffFrequency, double q=(1/sqrt(2)))

6.40.1 Detailed Description

Highpass.

6.40.2 Member Function Documentation

6.40.2.1 setup()

```
void Iir::RBJ::HighPass::setup (
        double sampleRate,
        double cutoffFrequency,
        double q = (1/sqrt(2)) )  [inline]
```

Calculates the coefficients

Parameters

sampleRate	Sampling rate
cutoffFrequency	Cutoff frequency
q	Q factor determines the resonance peak at the cutoff.

6.40.2.2 setupN()

```
void Iir::RBJ::HighPass::setupN (
        double cutoffFrequency,
        double q = (1/sqrt(2)) )
```

Calculates the coefficients

Parameters

cutoffFrequency	Normalised cutoff frequency (0..1/2)
q	Q factor determines the resonance peak at the cutoff.

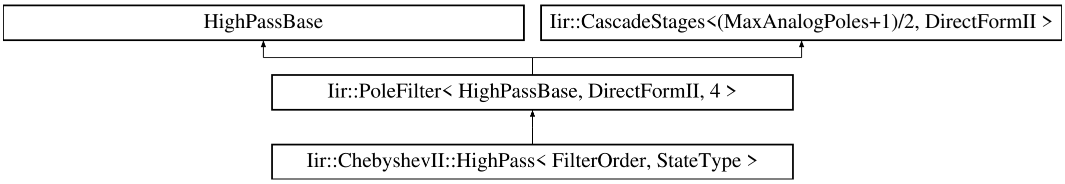
The documentation for this struct was generated from the following files:

- iir/RBJ.h
- iir/RBJ.cpp

6.41 Iir::ChebyshevII::HighPass< FilterOrder, StateType > Struct Template Reference

```
#include <ChebyshevII.h>
```

Inheritance diagram for Iir::ChebyshevII::HighPass< FilterOrder, StateType >:


HighPassBase
Iir::CascadeStages<(MaxAnalogPoles+1)/2, DirectFormII >
Iir::PoleFilter< HighPassBase, DirectFormII, 4 >
Iir::ChebyshevII::HighPass< FilterOrder, StateType >

Public Member Functions

- void setup (double sampleRate, double cutoffFrequency, double stopBandDb)
- void setup (int reqOrder, double sampleRate, double cutoffFrequency, double stopBandDb)
- void setupN (double cutoffFrequency, double stopBandDb)
- void setupN (int reqOrder, double cutoffFrequency, double stopBandDb)

6.41.1 Detailed Description

template<int FilterOrder = 4, class StateType = DirectFormII>
struct Iir::ChebyshevII::HighPass< FilterOrder, StateType >

ChebyshevII highpass filter

Parameters

FilterOrder	Reserves memory for a filter of the order FilterOrder
StateType	The filter topology: DirectFormI, DirectFormII, ...

6.41.2 Member Function Documentation

6.41.2.1 setup() [1/2]

```
template<int FilterOrder = 4, class StateType = DirectFormII>
void Iir::ChebyshevII::HighPass< FilterOrder, StateType >::setup (
            double sampleRate,
            double cutoffFrequency,
            double stopBandDb )  [inline]
```

Calculates the coefficients of the filter

Parameters

sampleRate	Sampling rate
cutoffFrequency	Cutoff frequency.

Parameters

stopBandDb	Permitted ripples in dB in the stopband

6.41.2.2 setup() [2/2] template<int FilterOrder = 4, class StateType = DirectFormII>

```
void Iir::ChebyshevII::HighPass< FilterOrder, StateType >::setup (
            int reqOrder,
            double sampleRate,
            double cutoffFrequency,
            double stopBandDb )  [inline]
```

Calculates the coefficients of the filter

Parameters

reqOrder	Requested order which can be less than the instantiated one
sampleRate	Sampling rate
cutoffFrequency	Cutoff frequency.
stopBandDb	Permitted ripples in dB in the stopband

6.41.2.3 setupN() [1/2] template<int FilterOrder = 4, class StateType = DirectFormII>

```
void Iir::ChebyshevII::HighPass< FilterOrder, StateType >::setupN (
            double cutoffFrequency,
            double stopBandDb )  [inline]
```

Calculates the coefficients of the filter

Parameters

cutoffFrequency	Normalised cutoff frequency (0..1/2)
stopBandDb	Permitted ripples in dB in the stopband

6.41.2.4 setupN() [2/2] template<int FilterOrder = 4, class StateType = DirectFormII>

```
void Iir::ChebyshevII::HighPass< FilterOrder, StateType >::setupN (
            int reqOrder,
            double cutoffFrequency,
            double stopBandDb )  [inline]
```

Calculates the coefficients of the filter

Parameters

reqOrder	Requested order which can be less than the instantiated one
cutoffFrequency	Normalised cutoff frequency (0..1/2)
stopBandDb	Permitted ripples in dB in the stopband

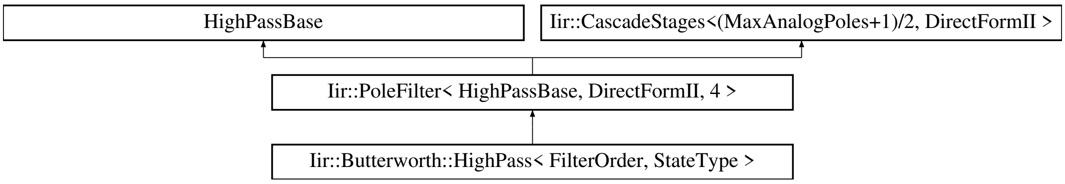
The documentation for this struct was generated from the following file:

- iir/ChebyshevII.h

6.42 Iir::Butterworth::HighPass< FilterOrder, StateType > Struct Template Reference

```
#include <Butterworth.h>
```

Inheritance diagram for Iir::Butterworth::HighPass< FilterOrder, StateType >:


HighPassBase
Iir::CascadeStages<(MaxAnalogPoles+1)/2, DirectFormII >
Iir::PoleFilter< HighPassBase, DirectFormII, 4 >
Iir::Butterworth::HighPass< FilterOrder, StateType >

Public Member Functions

- void setup (double sampleRate, double cutoffFrequency)
- void setup (int reqOrder, double sampleRate, double cutoffFrequency)
- void setupN (double cutoffFrequency)
- void setupN (int reqOrder, double cutoffFrequency)

6.42.1 Detailed Description

template<int FilterOrder = 4, class StateType = DirectFormII>
struct Iir::Butterworth::HighPass< FilterOrder, StateType >

Butterworth Highpass filter.

Parameters

FilterOrder	Reserves memory for a filter of the order FilterOrder
StateType	The filter topology: DirectFormI, DirectFormII, ...

6.42.2 Member Function Documentation

6.42.2.1 setup() [1/2] template<int FilterOrder = 4, class StateType = DirectFormII>

```
void Iir::Butterworth::HighPass< FilterOrder, StateType >::setup (
            double sampleRate,
            double cutoffFrequency )  [inline]
```

Calculates the coefficients with the filter order provided by the instantiation

Parameters

sampleRate	Sampling rate
cutoffFrequency	Cutoff frequency

6.42.2.2 setup() [2/2] template<int FilterOrder = 4, class StateType = DirectFormII>

```
void Iir::Butterworth::HighPass< FilterOrder, StateType >::setup (
            int reqOrder,
            double sampleRate,
            double cutoffFrequency )  [inline]
```

Calculates the coefficients

Parameters

reqOrder	The actual order which can be less than the instantiated one
sampleRate	Sampling rate

Parameters

cutoffFrequency	Cutoff frequency

6.42.2.3 setupN() [1/2]

```
template<int FilterOrder = 4, class StateType = DirectFormII>
void Iir::Butterworth::HighPass< FilterOrder, StateType >::setupN (
            double cutoffFrequency )  [inline]
```

Calculates the coefficients with the filter order provided by the instantiation

Parameters

cutoffFrequency	Normalised cutoff frequency (0..1/2)

6.42.2.4 setupN() [2/2]

```
template<int FilterOrder = 4, class StateType = DirectFormII>
void Iir::Butterworth::HighPass< FilterOrder, StateType >::setupN (
            int reqOrder,
            double cutoffFrequency )  [inline]
```

Calculates the coefficients

Parameters

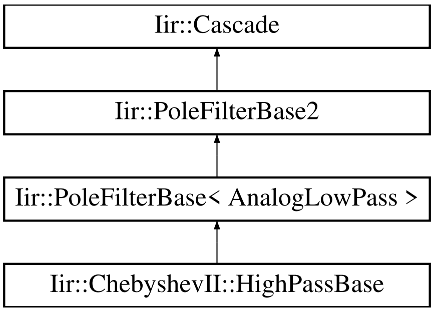
reqOrder	The actual order which can be less than the instantiated one
cutoffFrequency	Normalised cutoff frequency (0..1/2)

The documentation for this struct was generated from the following file:

- iir/Butterworth.h

6.43 Iir::ChebyshevII::HighPassBase Struct Reference

Inheritance diagram for Iir::ChebyshevII::HighPassBase:


Iir::Cascade
Iir::PoleFilterBase2
Iir::PoleFilterBase< AnalogLowPass >
Iir::ChebyshevII::HighPassBase

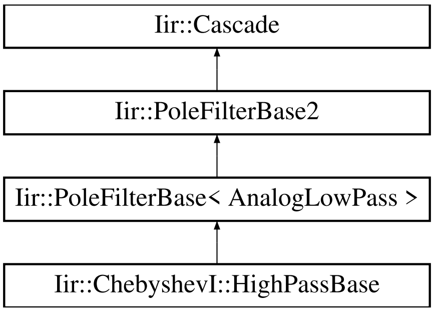
Additional Inherited Members

The documentation for this struct was generated from the following files:

- iir/ChebyshevII.h
- iir/ChebyshevII.cpp

6.44 Iir::ChebyshevI::HighPassBase Struct Reference

Inheritance diagram for Iir::ChebyshevI::HighPassBase:


Iir::Cascade
Iir::PoleFilterBase2
Iir::PoleFilterBase< AnalogLowPass >
Iir::ChebyshevI::HighPassBase

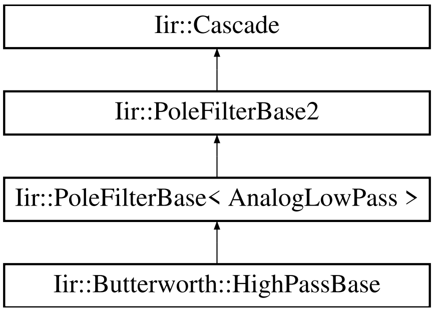
Additional Inherited Members

The documentation for this struct was generated from the following files:

- iir/ChebyshevI.h
- iir/ChebyshevI.cpp

6.45 Iir::Butterworth::HighPassBase Struct Reference

Inheritance diagram for Iir::Butterworth::HighPassBase:


Iir::Cascade
Iir::PoleFilterBase2
Iir::PoleFilterBase< AnalogLowPass >
Iir::Butterworth::HighPassBase

Additional Inherited Members

The documentation for this struct was generated from the following files:

- iir/Butterworth.h
- iir/Butterworth.cpp

6.46 Iir::HighPassTransform Class Reference

```
#include <PoleFilter.h>
```

6.46.1 Detailed Description

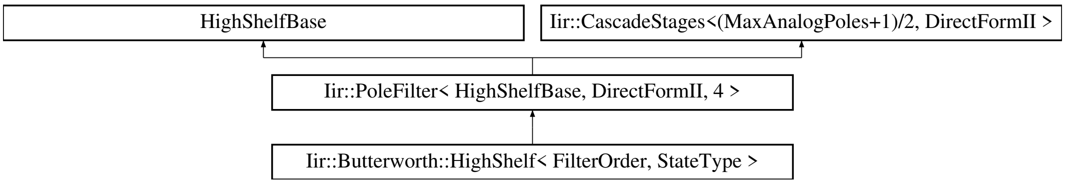
low pass to high pass
The documentation for this class was generated from the following files:

- iir/PoleFilter.h
- iir/PoleFilter.cpp

6.47 Iir::Butterworth::HighShelf< FilterOrder, StateType > Struct Template Reference

```
#include <Butterworth.h>
```

Inheritance diagram for Iir::Butterworth::HighShelf< FilterOrder, StateType >:


HighShelfBase
Iir::CascadeStages<(MaxAnalogPoles+1)/2, DirectFormII >
Iir::PoleFilter< HighShelfBase, DirectFormII, 4 >
Iir::Butterworth::HighShelf< FilterOrder, StateType >

Public Member Functions

- void setup (double sampleRate, double cutoffFrequency, double gainDb)
- void setup (int reqOrder, double sampleRate, double cutoffFrequency, double gainDb)
- void setupN (double cutoffFrequency, double gainDb)
- void setupN (int reqOrder, double cutoffFrequency, double gainDb)

6.47.1 Detailed Description

template<int FilterOrder = 4, class StateType = DirectFormII>
struct Iir::Butterworth::HighShelf< FilterOrder, StateType >

Butterworth high shelf filter. Above the cutoff the filter has a specified gain and below it has 0 dB.

Parameters

FilterOrder	Reserves memory for a filter of the order FilterOrder
StateType	The filter topology: DirectFormI, DirectFormII, ...

6.47.2 Member Function Documentation

6.47.2.1 setup() [1/2]

```
template<int FilterOrder = 4, class StateType = DirectFormII>
void Iir::Butterworth::HighShelf< FilterOrder, StateType >::setup (
            double sampleRate,
            double cutoffFrequency,
            double gainDb ) [inline]
```

Calculates the coefficients with the filter order provided by the instantiation

Parameters

sampleRate	Sampling rate
cutoffFrequency	Cutoff
gainDb	Gain in dB of the filter in the passband

6.47.2.2 setup() [2/2]

```
template<int FilterOrder = 4, class StateType = DirectFormII>
void Iir::Butterworth::HighShelf< FilterOrder, StateType >::setup (
            int reqOrder,
            double sampleRate,
            double cutoffFrequency,
            double gainDb ) [inline]
```

Calculates the coefficients

Parameters

reqOrder	The actual order which can be less than the instantiated one

Parameters

sampleRate	Sampling rate
cutoffFrequency	Cutoff
gainDb	Gain in dB of the filter in the passband

6.47.2.3 setupN() [1/2]

```
template<int FilterOrder = 4, class StateType = DirectFormII>
void Iir::Butterworth::HighShelf< FilterOrder, StateType >::setupN (
            double cutoffFrequency,
            double gainDb )  [inline]
```

Calculates the coefficients with the filter order provided by the instantiation

Parameters

cutoffFrequency	Normalised cutoff frequency (0..1/2)
gainDb	Gain in dB of the filter in the passband

6.47.2.4 setupN() [2/2]

```
template<int FilterOrder = 4, class StateType = DirectFormII>
void Iir::Butterworth::HighShelf< FilterOrder, StateType >::setupN (
            int reqOrder,
            double cutoffFrequency,
            double gainDb )  [inline]
```

Calculates the coefficients

Parameters

reqOrder	The actual order which can be less than the instantiated one
cutoffFrequency	Normalised cutoff frequency (0..1/2)
gainDb	Gain in dB of the filter in the passband

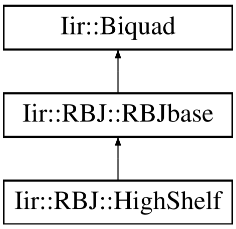
The documentation for this struct was generated from the following file:

- iir/Butterworth.h

6.48 Iir::RBJ::HighShelf Struct Reference

```
#include <RBJ.h>
```

Inheritance diagram for Iir::RBJ::HighShelf:



Public Member Functions

- void setupN (double cutoffFrequency, double gainDb, double shelfSlope=1)
- void setup (double sampleRate, double cutoffFrequency, double gainDb, double shelfSlope=1)

6.48.1 Detailed Description

High shelf: 0db in the stopband and gainDb in the passband.

6.48.2 Member Function Documentation

6.48.2.1 setup()

```
void Iir::RBJ::HighShelf::setup (
        double sampleRate,
        double cutoffFrequency,
        double gainDb,
        double shelfSlope = 1 )  [inline]
```

Calculates the coefficients

Parameters

sampleRate	Sampling rate
cutoffFrequency	Cutoff frequency
gainDb	Gain in the passband
shelfSlope	Slope between stop/passband. 1 = as steep as it can.

6.48.2.2 setupN()

```
void Iir::RBJ::HighShelf::setupN (
        double cutoffFrequency,
        double gainDb,
        double shelfSlope = 1 )
```

Calculates the coefficients

Parameters

cutoffFrequency	Normalised cutoff frequency
gainDb	Gain in the passband
shelfSlope	Slope between stop/passband. 1 = as steep as it can.

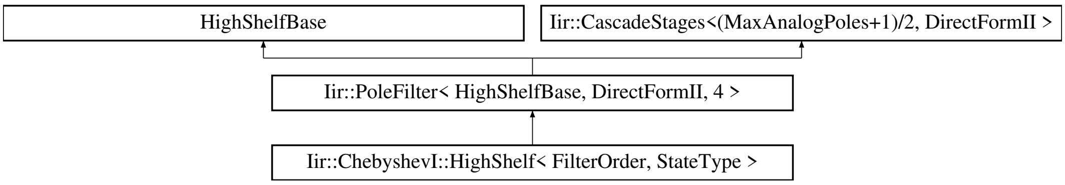
The documentation for this struct was generated from the following files:

- iir/RBJ.h
- iir/RBJ.cpp

6.49 Iir::ChebyshevI::HighShelf< FilterOrder, StateType > Struct Template Reference

```
#include <ChebyshevI.h>
```

Inheritance diagram for Iir::ChebyshevI::HighShelf< FilterOrder, StateType >:


HighShelfBase
Iir::CascadeStages<(MaxAnalogPoles+1)/2, DirectFormII >
Iir::PoleFilter< HighShelfBase, DirectFormII, 4 >
Iir::ChebyshevI::HighShelf< FilterOrder, StateType >

Public Member Functions

- void setup (double sampleRate, double cutoffFrequency, double gainDb, double rippleDb)
- void setup (int reqOrder, double sampleRate, double cutoffFrequency, double gainDb, double rippleDb)

- void setupN (double cutoffFrequency, double gainDb, double rippleDb)
- void setupN (int reqOrder, double cutoffFrequency, double gainDb, double rippleDb)

6.49.1 Detailed Description

template<int FilterOrder = 4, class StateType = DirectFormII>
struct Iir::ChebyshevI::HighShelf< FilterOrder, StateType >

ChebyshevI high shelf filter. Specified gain in the passband. Otherwise 0 dB.

Parameters

FilterOrder	Reserves memory for a filter of the order FilterOrder
StateType	The filter topology: DirectFormI, DirectFormII, ...

6.49.2 Member Function Documentation

6.49.2.1 setup() [1/2]

```
template<int FilterOrder = 4, class StateType = DirectFormII>
void Iir::ChebyshevI::HighShelf< FilterOrder, StateType >::setup (
            double sampleRate,
            double cutoffFrequency,
            double gainDb,
            double rippleDb )  [inline]
```

Calculates the coefficients of the filter at the order FilterOrder

Parameters

sampleRate	Sampling rate
cutoffFrequency	Cutoff frequency.
gainDb	Gain in the passband
rippleDb	Permitted ripples in dB in the passband

6.49.2.2 setup() [2/2]

```
template<int FilterOrder = 4, class StateType = DirectFormII>
void Iir::ChebyshevI::HighShelf< FilterOrder, StateType >::setup (
            int reqOrder,
            double sampleRate,
            double cutoffFrequency,
            double gainDb,
            double rippleDb )  [inline]
```

Calculates the coefficients of the filter at specified order

Parameters

reqOrder	Actual order for the filter calculations
sampleRate	Sampling rate
cutoffFrequency	Cutoff frequency.
gainDb	Gain in the passband
rippleDb	Permitted ripples in dB in the passband

6.49.2.3 setupN() [1/2]

```
template<int FilterOrder = 4, class StateType = DirectFormII>
void Iir::ChebyshevI::HighShelf< FilterOrder, StateType >::setupN (
            double cutoffFrequency,
            double gainDb,
            double rippleDb )  [inline]
```

Calculates the coefficients of the filter at the order FilterOrder

Parameters

cutoffFrequency	Normalised cutoff frequency (0..1/2)
gainDb	Gain in the passband
rippleDb	Permitted ripples in dB in the passband

6.49.2.4 setupN() [2/2]

```
template<int FilterOrder = 4, class StateType = DirectFormII>
void Iir::ChebyshevI::HighShelf< FilterOrder, StateType >::setupN (
            int reqOrder,
            double cutoffFrequency,
            double gainDb,
            double rippleDb )  [inline]
```

Calculates the coefficients of the filter at specified order

Parameters

reqOrder	Actual order for the filter calculations
cutoffFrequency	Normalised cutoff frequency (0..1/2)
gainDb	Gain in the passband
rippleDb	Permitted ripples in dB in the passband

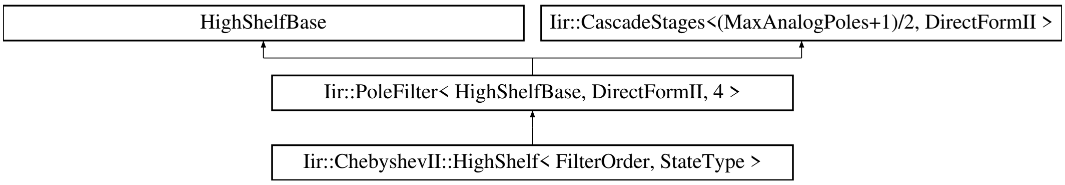
The documentation for this struct was generated from the following file:

- iir/ChebyshevI.h

6.50 Iir::ChebyshevII::HighShelf< FilterOrder, StateType > Struct Template Reference

```
#include <ChebyshevII.h>
```

Inheritance diagram for Iir::ChebyshevII::HighShelf< FilterOrder, StateType >:


HighShelfBase
Iir::CascadeStages<(MaxAnalogPoles+1)/2, DirectFormII >
Iir::PoleFilter< HighShelfBase, DirectFormII, 4 >
Iir::ChebyshevII::HighShelf< FilterOrder, StateType >

Public Member Functions

- void setup (double sampleRate, double cutoffFrequency, double gainDb, double stopBandDb)
- void setup (int reqOrder, double sampleRate, double cutoffFrequency, double gainDb, double stopBandDb)
- void setupN (double cutoffFrequency, double gainDb, double stopBandDb)
- void setupN (int reqOrder, double cutoffFrequency, double gainDb, double stopBandDb)

6.50.1 Detailed Description

template<int FilterOrder = 4, class StateType = DirectFormII>
struct Iir::ChebyshevII::HighShelf< FilterOrder, StateType >

ChebyshevII high shelf filter. Specified gain in the passband and 0dB in the stopband.

Parameters

FilterOrder	Reserves memory for a filter of the order FilterOrder
StateType	The filter topology: DirectFormI, DirectFormII, ...

6.50.2 Member Function Documentation

6.50.2.1 setup() [1/2]

```
template<int FilterOrder = 4, class StateType = DirectFormII>
void Iir::ChebyshevII::HighShelf< FilterOrder, StateType >::setup (
             double sampleRate,
             double cutoffFrequency,
             double gainDb,
             double stopBandDb )  [inline]
```

Calculates the coefficients of the filter

Parameters

sampleRate	Sampling rate
cutoffFrequency	Cutoff frequency.
gainDb	Gain the passbard. The stopband has 0 dB gain.
stopBandDb	Permitted ripples in dB in the stopband

6.50.2.2 setup() [2/2]

```
template<int FilterOrder = 4, class StateType = DirectFormII>
void Iir::ChebyshevII::HighShelf< FilterOrder, StateType >::setup (
             int reqOrder,
             double sampleRate,
             double cutoffFrequency,
             double gainDb,
             double stopBandDb )  [inline]
```

Calculates the coefficients of the filter

Parameters

reqOrder	Requested order which can be less than the instantiated one
sampleRate	Sampling rate
cutoffFrequency	Cutoff frequency.
gainDb	Gain the passbard. The stopband has 0 dB gain.
stopBandDb	Permitted ripples in dB in the stopband

6.50.2.3 setupN() [1/2]

```
template<int FilterOrder = 4, class StateType = DirectFormII>
void Iir::ChebyshevII::HighShelf< FilterOrder, StateType >::setupN (
             double cutoffFrequency,
             double gainDb,
             double stopBandDb )  [inline]
```

Calculates the coefficients of the filter

Parameters

cutoffFrequency	Normalised cutoff frequency (0..1/2)
gainDb	Gain the passbard. The stopband has 0 dB gain.
stopBandDb	Permitted ripples in dB in the stopband

6.50.2.4 setupN() [2/2]

```
template<int FilterOrder = 4, class StateType = DirectFormII>
void Iir::ChebyshevII::HighShelf< FilterOrder, StateType >::setupN (
             int reqOrder,
             double cutoffFrequency,
             double gainDb,
             double stopBandDb )  [inline]
```

Calculates the coefficients of the filter

Parameters

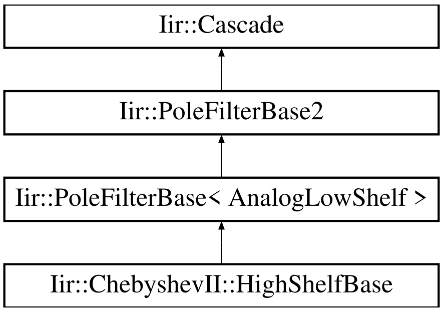
reqOrder	Requested order which can be less than the instantiated one
cutoffFrequency	Normalised cutoff frequency (0..1/2)
gainDb	Gain the passbard. The stopband has 0 dB gain.
stopBandDb	Permitted ripples in dB in the stopband

The documentation for this struct was generated from the following file:

- iir/ChebyshevII.h

6.51 Iir::ChebyshevII::HighShelfBase Struct Reference

Inheritance diagram for Iir::ChebyshevII::HighShelfBase:


Iir::Cascade
Iir::PoleFilterBase2
Iir::PoleFilterBase< AnalogLowShelf >
Iir::ChebyshevII::HighShelfBase

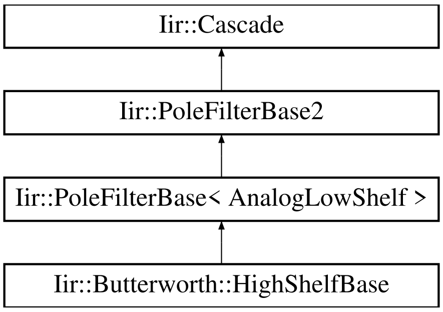
Additional Inherited Members

The documentation for this struct was generated from the following files:

- iir/ChebyshevII.h
- iir/ChebyshevII.cpp

6.52 Iir::Butterworth::HighShelfBase Struct Reference

Inheritance diagram for Iir::Butterworth::HighShelfBase:


Iir::Cascade
Iir::PoleFilterBase2
Iir::PoleFilterBase< AnalogLowShelf >
Iir::Butterworth::HighShelfBase

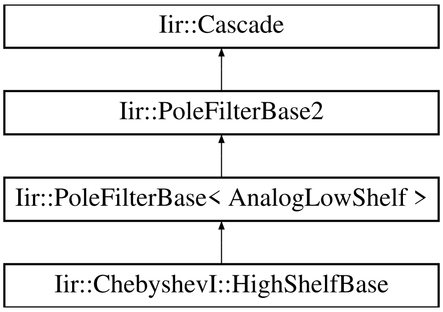
Additional Inherited Members

The documentation for this struct was generated from the following files:

- iir/Butterworth.h
- iir/Butterworth.cpp

6.53 Iir::ChebyshevI::HighShelfBase Struct Reference

Inheritance diagram for Iir::ChebyshevI::HighShelfBase:


Iir::Cascade
Iir::PoleFilterBase2
Iir::PoleFilterBase< AnalogLowShelf >
Iir::ChebyshevI::HighShelfBase

Additional Inherited Members

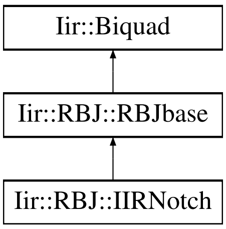
The documentation for this struct was generated from the following files:

- iir/ChebyshevI.h
- iir/ChebyshevI.cpp

6.54 Iir::RBJ::IIRNotch Struct Reference

`#include <RBJ.h>`

Inheritance diagram for Iir::RBJ::IIRNotch:



Public Member Functions

- void setupN (double centerFrequency, double q_factor=10)
- void setup (double sampleRate, double centerFrequency, double q_factor=10)

6.54.1 Detailed Description

Bandstop with Q factor: the higher the Q factor the more narrow is the notch. However, a narrow notch has a long impulse response (= ringing) and numerical problems might prevent perfect damping. Practical values of the Q factor are about Q = 10 to 20. In terms of the design the Q factor defines the radius of the poles as r = exp(-pi∗(centerFrequency/sampleRate)/q_factor) whereas the angles of the poles/zeros define the bandstop frequency. The higher Q the closer r moves towards the unit circle.

6.54.2 Member Function Documentation

6.54.2.1 setup()

```
void Iir::RBJ::IIRNotch::setup (
        double sampleRate,
        double centerFrequency,
        double q_factor = 10 )  [inline]
```

Calculates the coefficients

Parameters

sampleRate	Sampling rate
centerFrequency	Center frequency of the notch
q_factor	Q factor of the notch (1 to ∼20)

6.54.2.2 setupN()

```
void Iir::RBJ::IIRNotch::setupN (
        double centerFrequency,
        double q_factor = 10 )
```

Calculates the coefficients

Parameters

centerFrequency	Normalised centre frequency of the notch
q_factor	Q factor of the notch (1 to ∼20)

The documentation for this struct was generated from the following files:

- iir/RBJ.h
- iir/RBJ.cpp

6.55 Iir::Layout< MaxPoles > Class Template Reference

```
#include <Layout.h>
```

6.55.1 Detailed Description

template<int MaxPoles>
class Iir::Layout< MaxPoles >

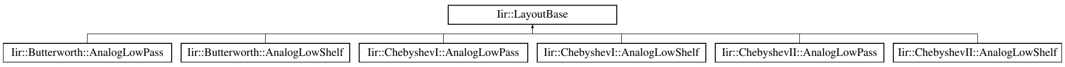
Storage for Layout
The documentation for this class was generated from the following file:

- iir/Layout.h

6.56 Iir::LayoutBase Class Reference

```
#include <Layout.h>
```

Inheritance diagram for Iir::LayoutBase:


Iir::LayoutBase
Iir::Butterworth::AnalogLowPass
Iir::Butterworth::AnalogLowShelf
Iir::ChebyshevI::AnalogLowPass
Iir::ChebyshevI::AnalogLowShelf
Iir::ChebyshevII::AnalogLowPass
Iir::ChebyshevII::AnalogLowShelf

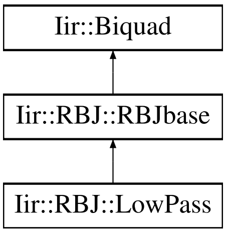
6.56.1 Detailed Description

Base uses pointers to reduce template instantiations
The documentation for this class was generated from the following file:

- iir/Layout.h

6.57 Iir::RBJ::LowPass Struct Reference

`#include <RBJ.h>`
Inheritance diagram for Iir::RBJ::LowPass:



Public Member Functions

- void setupN (double cutoffFrequency, double q=(1/sqrt(2)))
- void setup (double sampleRate, double cutoffFrequency, double q=(1/sqrt(2)))

6.57.1 Detailed Description

Lowpass.

6.57.2 Member Function Documentation

6.57.2.1 setup()

```
void Iir::RBJ::LowPass::setup (
        double sampleRate,
        double cutoffFrequency,
        double q = (1/sqrt(2)) )  [inline]
```

Calculates the coefficients

Parameters

sampleRate	Sampling rate
cutoffFrequency	Cutoff frequency
q	Q factor determines the resonance peak at the cutoff.

6.57.2.2 setupN()

```
void Iir::RBJ::LowPass::setupN (
        double cutoffFrequency,
        double q = (1/sqrt(2)) )
```

Calculates the coefficients

Parameters

cutoffFrequency	Normalised cutoff frequency
q	Q factor determines the resonance peak at the cutoff.

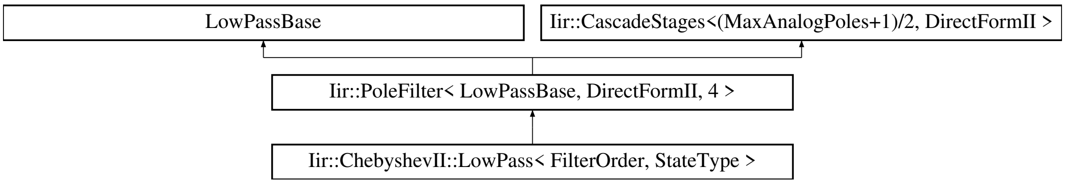
The documentation for this struct was generated from the following files:

- iir/RBJ.h
- iir/RBJ.cpp

6.58 Iir::ChebyshevII::LowPass< FilterOrder, StateType > Struct Template Reference

`#include <ChebyshevII.h>`

Inheritance diagram for Iir::ChebyshevII::LowPass< FilterOrder, StateType >:


LowPassBase
Iir::CascadeStages<(MaxAnalogPoles+1)/2, DirectFormII >
Iir::PoleFilter< LowPassBase, DirectFormII, 4 >
Iir::ChebyshevII::LowPass< FilterOrder, StateType >

Public Member Functions

- void setup (double sampleRate, double cutoffFrequency, double stopBandDb)
- void setup (int reqOrder, double sampleRate, double cutoffFrequency, double stopBandDb)
- void setupN (double cutoffFrequency, double stopBandDb)
- void setupN (int reqOrder, double cutoffFrequency, double stopBandDb)

6.58.1 Detailed Description

template<int FilterOrder = 4, class StateType = DirectFormII>
struct Iir::ChebyshevII::LowPass< FilterOrder, StateType >

ChebyshevII lowpass filter

Parameters

FilterOrder	Reserves memory for a filter of the order FilterOrder
StateType	The filter topology: DirectFormI, DirectFormII, ...

6.58.2 Member Function Documentation

6.58.2.1 setup() [1/2]

```
template<int FilterOrder = 4, class StateType = DirectFormII>
void Iir::ChebyshevII::LowPass< FilterOrder, StateType >::setup (
            double sampleRate,
            double cutoffFrequency,
            double stopBandDb )  [inline]
```

Calculates the coefficients of the filter

Parameters

sampleRate	Sampling rate
cutoffFrequency	Cutoff frequency.

Parameters

stopBandDb	Permitted ripples in dB in the stopband

6.58.2.2 setup() [2/2] template<int FilterOrder = 4, class StateType = DirectFormII>

```
void Iir::ChebyshevII::LowPass< FilterOrder, StateType >::setup (
            int reqOrder,
            double sampleRate,
            double cutoffFrequency,
            double stopBandDb )  [inline]
```

Calculates the coefficients of the filter

Parameters

reqOrder	Requested order which can be less than the instantiated one
sampleRate	Sampling rate
cutoffFrequency	Cutoff frequency.
stopBandDb	Permitted ripples in dB in the stopband

6.58.2.3 setupN() [1/2] template<int FilterOrder = 4, class StateType = DirectFormII>

```
void Iir::ChebyshevII::LowPass< FilterOrder, StateType >::setupN (
            double cutoffFrequency,
            double stopBandDb )  [inline]
```

Calculates the coefficients of the filter

Parameters

cutoffFrequency	Normalised cutoff frequency (0..1/2)
stopBandDb	Permitted ripples in dB in the stopband

6.58.2.4 setupN() [2/2] template<int FilterOrder = 4, class StateType = DirectFormII>

```
void Iir::ChebyshevII::LowPass< FilterOrder, StateType >::setupN (
            int reqOrder,
            double cutoffFrequency,
            double stopBandDb )  [inline]
```

Calculates the coefficients of the filter

Parameters

reqOrder	Requested order which can be less than the instantiated one
cutoffFrequency	Normalised cutoff frequency (0..1/2)
stopBandDb	Permitted ripples in dB in the stopband

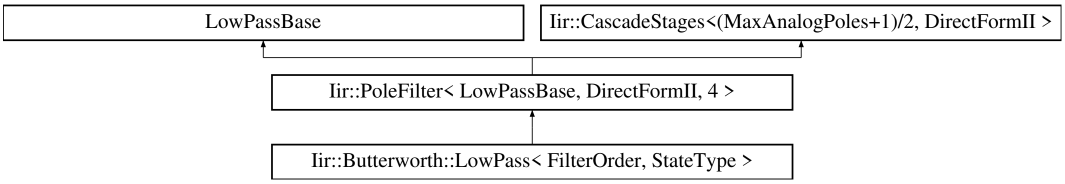
The documentation for this struct was generated from the following file:

- iir/ChebyshevII.h

6.59 Iir::Butterworth::LowPass< FilterOrder, StateType > Struct Template Reference

```
#include <Butterworth.h>
```

Inheritance diagram for Iir::Butterworth::LowPass< FilterOrder, StateType >:


LowPassBase
Iir::CascadeStages<(MaxAnalogPoles+1)/2, DirectFormII >
Iir::PoleFilter< LowPassBase, DirectFormII, 4 >
Iir::Butterworth::LowPass< FilterOrder, StateType >

Public Member Functions

- void setup (double sampleRate, double cutoffFrequency)
- void setup (int reqOrder, double sampleRate, double cutoffFrequency)
- void setupN (double cutoffFrequency)
- void setupN (int reqOrder, double cutoffFrequency)

6.59.1 Detailed Description

template< int FilterOrder = 4, class StateType = DirectFormII>
struct Iir::Butterworth::LowPass< FilterOrder, StateType >

Butterworth Lowpass filter.

Parameters

FilterOrder	Reserves memory for a filter of the order FilterOrder
StateType	The filter topology: DirectFormI, DirectFormII, ...

6.59.2 Member Function Documentation

6.59.2.1 setup() [1/2]

```
template<int FilterOrder = 4, class StateType = DirectFormII>
void Iir::Butterworth::LowPass< FilterOrder, StateType >::setup (
            double sampleRate,
            double cutoffFrequency )  [inline]
```

Calculates the coefficients

Parameters

sampleRate	Sampling rate
cutoffFrequency	Cutoff

6.59.2.2 setup() [2/2]

```
template<int FilterOrder = 4, class StateType = DirectFormII>
void Iir::Butterworth::LowPass< FilterOrder, StateType >::setup (
            int reqOrder,
            double sampleRate,
            double cutoffFrequency )  [inline]
```

Calculates the coefficients

Parameters

reqOrder	The actual order which can be less than the instantiated one
sampleRate	Sampling rate

Parameters

cutoffFrequency	Cutoff

6.59.2.3 setupN() [1/2]

```
template<int FilterOrder = 4, class StateType = DirectFormII>
void Iir::Butterworth::LowPass< FilterOrder, StateType >::setupN (
            double cutoffFrequency )  [inline]
```

Calculates the coefficients

Parameters

cutoffFrequency	Normalised cutoff frequency (0..1/2)

6.59.2.4 setupN() [2/2]

```
template<int FilterOrder = 4, class StateType = DirectFormII>
void Iir::Butterworth::LowPass< FilterOrder, StateType >::setupN (
            int reqOrder,
            double cutoffFrequency )  [inline]
```

Calculates the coefficients

Parameters

reqOrder	The actual order which can be less than the instantiated one
cutoffFrequency	Normalised cutoff frequency (0..1/2)

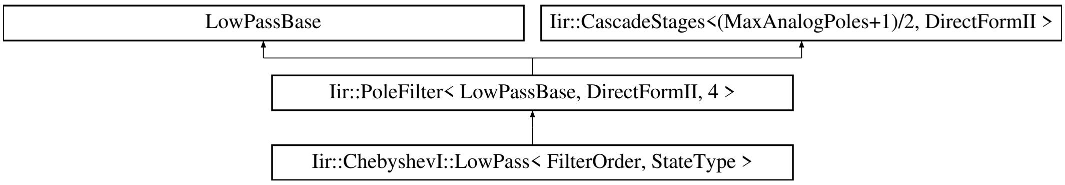
The documentation for this struct was generated from the following file:

- iir/Butterworth.h

6.60 Iir::ChebyshevI::LowPass< FilterOrder, StateType > Struct Template Reference

```
#include <ChebyshevI.h>
```

Inheritance diagram for Iir::ChebyshevI::LowPass< FilterOrder, StateType >:


LowPassBase
Iir::CascadeStages<(MaxAnalogPoles+1)/2, DirectFormII >
Iir::PoleFilter< LowPassBase, DirectFormII, 4 >
Iir::ChebyshevI::LowPass< FilterOrder, StateType >

Public Member Functions

- void setup (double sampleRate, double cutoffFrequency, double rippleDb)
- void setup (int reqOrder, double sampleRate, double cutoffFrequency, double rippleDb)
- void setupN (double cutoffFrequency, double rippleDb)
- void setupN (int reqOrder, double cutoffFrequency, double rippleDb)

6.60.1 Detailed Description

template<int FilterOrder = 4, class StateType = DirectFormII>
struct Iir::ChebyshevI::LowPass< FilterOrder, StateType >

ChebyshevI lowpass filter

Parameters

FilterOrder	Reserves memory for a filter of the order FilterOrder
StateType	The filter topology: DirectFormI, DirectFormII, ...

6.60.2 Member Function Documentation

6.60.2.1 setup() [1/2]

```
template<int FilterOrder = 4, class StateType = DirectFormII>
void Iir::ChebyshevI::LowPass< FilterOrder, StateType >::setup (
            double sampleRate,
            double cutoffFrequency,
            double rippleDb )  [inline]
```

Calculates the coefficients of the filter at the order FilterOrder

Parameters

sampleRate	Sampling rate
cutoffFrequency	Cutoff frequency
rippleDb	Permitted ripples in dB in the passband

6.60.2.2 setup() [2/2]

```
template<int FilterOrder = 4, class StateType = DirectFormII>
void Iir::ChebyshevI::LowPass< FilterOrder, StateType >::setup (
            int reqOrder,
            double sampleRate,
            double cutoffFrequency,
            double rippleDb )  [inline]
```

Calculates the coefficients of the filter at specified order

Parameters

reqOrder	Actual order for the filter calculations
sampleRate	Sampling rate
cutoffFrequency	Cutoff frequency.
rippleDb	Permitted ripples in dB in the passband

6.60.2.3 setupN() [1/2]

```
template<int FilterOrder = 4, class StateType = DirectFormII>
void Iir::ChebyshevI::LowPass< FilterOrder, StateType >::setupN (
            double cutoffFrequency,
            double rippleDb )  [inline]
```

Calculates the coefficients of the filter at the order FilterOrder

Parameters

cutoffFrequency	Normalised cutoff frequency (0..1/2)
rippleDb	Permitted ripples in dB in the passband

6.60.2.4 setupN() [2/2]

```
template<int FilterOrder = 4, class StateType = DirectFormII>
void Iir::ChebyshevI::LowPass< FilterOrder, StateType >::setupN (
            int reqOrder,
            double cutoffFrequency,
            double rippleDb )  [inline]
```

Calculates the coefficients of the filter at specified order

Parameters

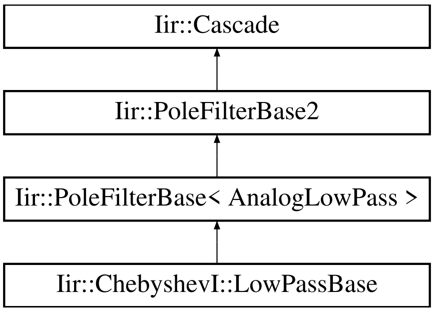
reqOrder	Actual order for the filter calculations
cutoffFrequency	Normalised cutoff frequency (0..1/2)
rippleDb	Permitted ripples in dB in the passband

The documentation for this struct was generated from the following file:

- iir/ChebyshevI.h

6.61 Iir::ChebyshevI::LowPassBase Struct Reference

Inheritance diagram for Iir::ChebyshevI::LowPassBase:


Iir::Cascade
Iir::PoleFilterBase2
Iir::PoleFilterBase< AnalogLowPass >
Iir::ChebyshevI::LowPassBase

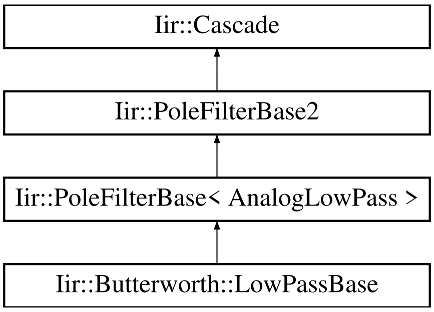
Additional Inherited Members

The documentation for this struct was generated from the following files:

- iir/ChebyshevI.h
- iir/ChebyshevI.cpp

6.62 Iir::Butterworth::LowPassBase Struct Reference

Inheritance diagram for Iir::Butterworth::LowPassBase:


Iir::Cascade
Iir::PoleFilterBase2
Iir::PoleFilterBase< AnalogLowPass >
Iir::Butterworth::LowPassBase

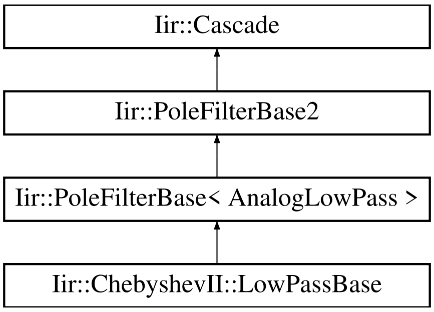
Additional Inherited Members

The documentation for this struct was generated from the following files:

- iir/Butterworth.h
- iir/Butterworth.cpp

6.63 Iir::ChebyshevII::LowPassBase Struct Reference

Inheritance diagram for Iir::ChebyshevII::LowPassBase:


Iir::Cascade
Iir::PoleFilterBase2
Iir::PoleFilterBase< AnalogLowPass >
Iir::ChebyshevII::LowPassBase

Additional Inherited Members

The documentation for this struct was generated from the following files:

- iir/ChebyshevII.h
- iir/ChebyshevII.cpp

6.64 Iir::LowPassTransform Class Reference

```
#include <PoleFilter.h>
```

6.64.1 Detailed Description

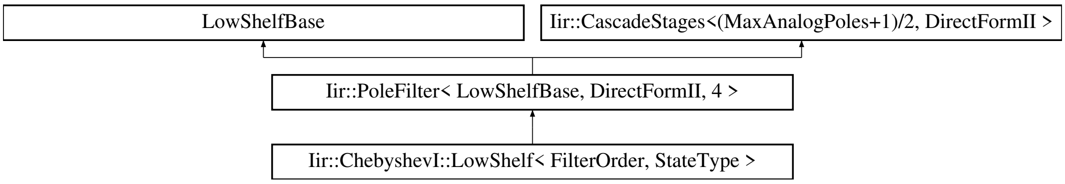
s-plane to z-plane transforms
For pole filters, an analog prototype is created via placement of poles and zeros in the s-plane. The analog prototype is either a halfband low pass or a halfband low shelf. The poles, zeros, and normalization parameters are transformed into the z-plane using variants of the bilinear transformation. low pass to low pass
The documentation for this class was generated from the following files:

- iir/PoleFilter.h
- iir/PoleFilter.cpp

6.65 Iir::ChebyshevI::LowShelf< FilterOrder, StateType > Struct Template Reference

```
#include <ChebyshevI.h>
```

Inheritance diagram for Iir::ChebyshevI::LowShelf< FilterOrder, StateType >:


LowShelfBase
Iir::CascadeStages<(MaxAnalogPoles+1)/2, DirectFormII >
Iir::PoleFilter< LowShelfBase, DirectFormII, 4 >
Iir::ChebyshevI::LowShelf< FilterOrder, StateType >

Public Member Functions

- void setup (double sampleRate, double cutoffFrequency, double gainDb, double rippleDb)
- void setup (int reqOrder, double sampleRate, double cutoffFrequency, double gainDb, double rippleDb)
- void setupN (double cutoffFrequency, double gainDb, double rippleDb)
- void setupN (int reqOrder, double cutoffFrequency, double gainDb, double rippleDb)

6.65.1 Detailed Description

template<int FilterOrder = 4, class StateType = DirectFormII>
struct Iir::ChebyshevI::LowShelf< FilterOrder, StateType >

ChebyshevI low shelf filter. Specified gain in the passband. Otherwise 0 dB.

Parameters

FilterOrder	Reserves memory for a filter of the order FilterOrder
StateType	The filter topology: DirectFormI, DirectFormII, ...

6.65.2 Member Function Documentation

6.65.2.1 setup() [1/2]

```
template<int FilterOrder = 4, class StateType = DirectFormII>
void Iir::ChebyshevI::LowShelf< FilterOrder, StateType >::setup (
            double sampleRate,
            double cutoffFrequency,
            double gainDb,
            double rippleDb )  [inline]
```

Calculates the coefficients of the filter at the order FilterOrder

Parameters

sampleRate	Sampling rate
cutoffFrequency	Cutoff frequency.
gainDb	Gain in the passband
rippleDb	Permitted ripples in dB in the passband

6.65.2.2 setup() [2/2]

```
template<int FilterOrder = 4, class StateType = DirectFormII>
void Iir::ChebyshevI::LowShelf< FilterOrder, StateType >::setup (
            int reqOrder,
            double sampleRate,
            double cutoffFrequency,
            double gainDb,
            double rippleDb )  [inline]
```

Calculates the coefficients of the filter at specified order

Parameters

reqOrder	Actual order for the filter calculations
sampleRate	Sampling rate
cutoffFrequency	Cutoff frequency.
gainDb	Gain in the passband
rippleDb	Permitted ripples in dB in the passband

6.65.2.3 setupN() [1/2]

```
template<int FilterOrder = 4, class StateType = DirectFormII>
void Iir::ChebyshevI::LowShelf< FilterOrder, StateType >::setupN (
            double cutoffFrequency,
            double gainDb,
            double rippleDb )  [inline]
```

Calculates the coefficients of the filter at the order FilterOrder

Parameters

cutoffFrequency	Normalised cutoff frequency (0..1/2)
gainDb	Gain in the passband
rippleDb	Permitted ripples in dB in the passband

6.65.2.4 setupN() [2/2]

```
template<int FilterOrder = 4, class StateType = DirectFormII>
void Iir::ChebyshevI::LowShelf< FilterOrder, StateType >::setupN (
            int reqOrder,
            double cutoffFrequency,
            double gainDb,
            double rippleDb )  [inline]
```

Calculates the coefficients of the filter at specified order

Parameters

reqOrder	Actual order for the filter calculations
cutoffFrequency	Normalised cutoff frequency (0..1/2)
gainDb	Gain in the passband
rippleDb	Permitted ripples in dB in the passband

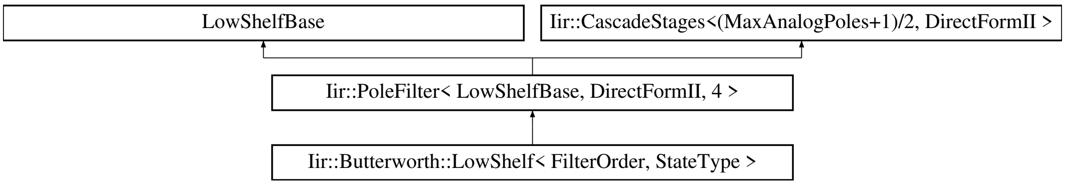
The documentation for this struct was generated from the following file:

- iir/ChebyshevI.h

6.66 Iir::Butterworth::LowShelf< FilterOrder, StateType > Struct Template Reference

```
#include <Butterworth.h>
```

Inheritance diagram for Iir::Butterworth::LowShelf< FilterOrder, StateType >:


LowShelfBase
Iir::CascadeStages<(MaxAnalogPoles+1)/2, DirectFormII >
Iir::PoleFilter< LowShelfBase, DirectFormII, 4 >
Iir::Butterworth::LowShelf< FilterOrder, StateType >

Public Member Functions

- void setup (double sampleRate, double cutoffFrequency, double gainDb)
- void setup (int reqOrder, double sampleRate, double cutoffFrequency, double gainDb)
- void setupN (double cutoffFrequency, double gainDb)
- void setupN (int reqOrder, double cutoffFrequency, double gainDb)

6.66.1 Detailed Description

template<int FilterOrder = 4, class StateType = DirectFormII>
struct Iir::Butterworth::LowShelf< FilterOrder, StateType >

Butterworth low shelf filter: below the cutoff it has a specified gain and above the cutoff the gain is 0 dB.

Parameters

FilterOrder	Reserves memory for a filter of the order FilterOrder
StateType	The filter topology: DirectFormI, DirectFormII, ...

6.66.2 Member Function Documentation

6.66.2.1 setup() [1/2]

```
template<int FilterOrder = 4, class StateType = DirectFormII>
void Iir::Butterworth::LowShelf< FilterOrder, StateType >::setup (
              double sampleRate,
              double cutoffFrequency,
              double gainDb )  [inline]
```

Calculates the coefficients with the filter order provided by the instantiation

Parameters

sampleRate	Sampling rate
cutoffFrequency	Cutoff
gainDb	Gain in dB of the filter in the passband

6.66.2.2 setup() [2/2]

```
template<int FilterOrder = 4, class StateType = DirectFormII>
void Iir::Butterworth::LowShelf< FilterOrder, StateType >::setup (
              int reqOrder,
              double sampleRate,
              double cutoffFrequency,
              double gainDb )  [inline]
```

Calculates the coefficients

Parameters

reqOrder	The actual order which can be less than the instantiated one
sampleRate	Sampling rate
cutoffFrequency	Cutoff
gainDb	Gain in dB of the filter in the passband

6.66.2.3 setupN() [1/2]

```
template<int FilterOrder = 4, class StateType = DirectFormII>
void Iir::Butterworth::LowShelf< FilterOrder, StateType >::setupN (
              double cutoffFrequency,
              double gainDb )  [inline]
```

Calculates the coefficients with the filter order provided by the instantiation

Parameters

cutoffFrequency	Normalised cutoff frequency (0..1/2)
gainDb	Gain in dB of the filter in the passband

6.66.2.4 setupN() [2/2]

```
template<int FilterOrder = 4, class StateType = DirectFormII>
void Iir::Butterworth::LowShelf< FilterOrder, StateType >::setupN (
            int reqOrder,
            double cutoffFrequency,
            double gainDb )  [inline]
```

Calculates the coefficients

Parameters

reqOrder	The actual order which can be less than the instantiated one
cutoffFrequency	Normalised cutoff frequency (0..1/2)
gainDb	Gain in dB of the filter in the passband

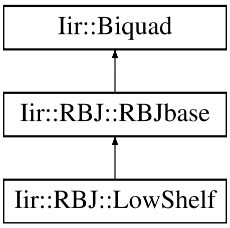
The documentation for this struct was generated from the following file:

- iir/Butterworth.h

6.67 Iir::RBJ::LowShelf Struct Reference

```
#include <RBJ.h>
```

Inheritance diagram for Iir::RBJ::LowShelf:



Public Member Functions

- void setupN (double cutoffFrequency, double gainDb, double shelfSlope=1)
- void setup (double sampleRate, double cutoffFrequency, double gainDb, double shelfSlope=1)

6.67.1 Detailed Description

Low shelf: 0db in the stopband and gainDb in the passband.

6.67.2 Member Function Documentation

6.67.2.1 setup()

```
void Iir::RBJ::LowShelf::setup (
            double sampleRate,
            double cutoffFrequency,
            double gainDb,
            double shelfSlope = 1 )  [inline]
```

Calculates the coefficients

Parameters

sampleRate	Sampling rate
cutoffFrequency	Cutoff frequency
gainDb	Gain in the passband
shelfSlope	Slope between stop/passband. 1 = as steep as it can.

6.67.2.2 setupN()

```
void Iir::RBJ::LowShelf::setupN (
          double cutoffFrequency,
          double gainDb,
          double shelfSlope = 1 )
```

Calculates the coefficients

Parameters

cutoffFrequency	Normalised cutoff frequency
gainDb	Gain in the passband
shelfSlope	Slope between stop/passband. 1 = as steep as it can.

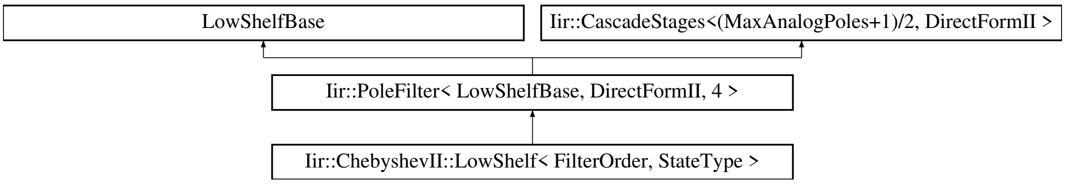
The documentation for this struct was generated from the following files:

- iir/RBJ.h
- iir/RBJ.cpp

6.68 Iir::ChebyshevII::LowShelf< FilterOrder, StateType > Struct Template Reference

```
#include <ChebyshevII.h>
```

Inheritance diagram for Iir::ChebyshevII::LowShelf< FilterOrder, StateType >:


LowShelfBase
Iir::CascadeStages<(MaxAnalogPoles+1)/2, DirectFormII >
Iir::PoleFilter< LowShelfBase, DirectFormII, 4 >
Iir::ChebyshevII::LowShelf< FilterOrder, StateType >

Public Member Functions

- void setup (double sampleRate, double cutoffFrequency, double gainDb, double stopBandDb)
- void setup (int reqOrder, double sampleRate, double cutoffFrequency, double gainDb, double stopBandDb)
- void setupN (double cutoffFrequency, double gainDb, double stopBandDb)
- void setupN (int reqOrder, double cutoffFrequency, double gainDb, double stopBandDb)

6.68.1 Detailed Description

template<int FilterOrder = 4, class StateType = DirectFormII>
struct Iir::ChebyshevII::LowShelf< FilterOrder, StateType >

ChebyshevII low shelf filter. Specified gain in the passband and 0dB in the stopband.

Parameters

FilterOrder	Reserves memory for a filter of the order FilterOrder
StateType	The filter topology: DirectFormI, DirectFormII, ...

6.68.2 Member Function Documentation

6.68.2.1 setup() [1/2]

```
template<int FilterOrder = 4, class StateType = DirectFormII>
void Iir::ChebyshevII::LowShelf< FilterOrder, StateType >::setup (
            double sampleRate,
            double cutoffFrequency,
            double gainDb,
            double stopBandDb )  [inline]
```

Calculates the coefficients of the filter

Parameters

sampleRate	Sampling rate
cutoffFrequency	Cutoff frequency.
gainDb	Gain of the passbard. The stopband has 0 dB gain.
stopBandDb	Permitted ripples in dB in the stopband

6.68.2.2 setup() [2/2] template<int FilterOrder = 4, class StateType = DirectFormII>

```
void Iir::ChebyshevII::LowShelf< FilterOrder, StateType >::setup (
            int reqOrder,
            double sampleRate,
            double cutoffFrequency,
            double gainDb,
            double stopBandDb )  [inline]
```

Calculates the coefficients of the filter

Parameters

reqOrder	Requested order which can be less than the instantiated one
sampleRate	Sampling rate
cutoffFrequency	Cutoff frequency
gainDb	Gain of the passbard. The stopband has 0 dB gain.
stopBandDb	Permitted ripples in dB in the stopband

6.68.2.3 setupN() [1/2] template<int FilterOrder = 4, class StateType = DirectFormII>

```
void Iir::ChebyshevII::LowShelf< FilterOrder, StateType >::setupN (
            double cutoffFrequency,
            double gainDb,
            double stopBandDb )  [inline]
```

Calculates the coefficients of the filter

Parameters

cutoffFrequency	Normalised cutoff frequency (0..1/2)
gainDb	Gain of the passbard. The stopband has 0 dB gain.
stopBandDb	Permitted ripples in dB in the stopband

6.68.2.4 setupN() [2/2] template<int FilterOrder = 4, class StateType = DirectFormII>

```
void Iir::ChebyshevII::LowShelf< FilterOrder, StateType >::setupN (
            int reqOrder,
            double cutoffFrequency,
            double gainDb,
            double stopBandDb )  [inline]
```

Calculates the coefficients of the filter

Parameters

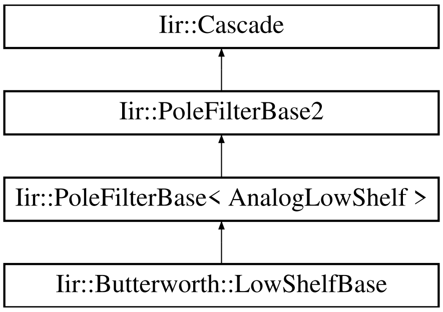
reqOrder	Requested order which can be less than the instantiated one
cutoffFrequency	Normalised cutoff frequency (0..1/2)
gainDb	Gain the passbard. The stopband has 0 dB gain.
stopBandDb	Permitted ripples in dB in the stopband

The documentation for this struct was generated from the following file:

- iir/ChebyshevII.h

6.69 Iir::Butterworth::LowShelfBase Struct Reference

Inheritance diagram for Iir::Butterworth::LowShelfBase:


Iir::Cascade
Iir::PoleFilterBase2
Iir::PoleFilterBase< AnalogLowShelf >
Iir::Butterworth::LowShelfBase

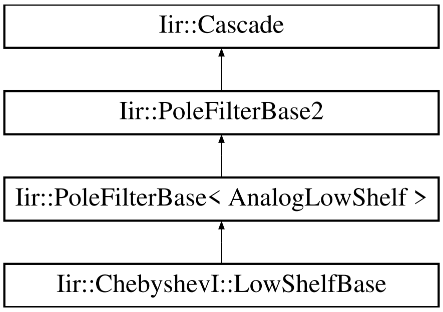
Additional Inherited Members

The documentation for this struct was generated from the following files:

- iir/Butterworth.h
- iir/Butterworth.cpp

6.70 Iir::ChebyshevI::LowShelfBase Struct Reference

Inheritance diagram for Iir::ChebyshevI::LowShelfBase:


Iir::Cascade
Iir::PoleFilterBase2
Iir::PoleFilterBase< AnalogLowShelf >
Iir::ChebyshevI::LowShelfBase

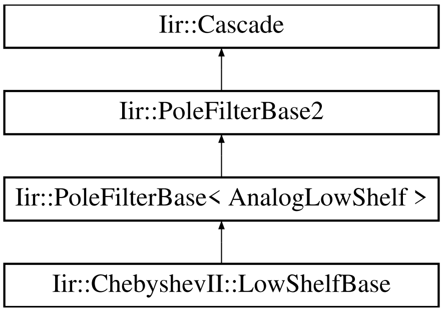
Additional Inherited Members

The documentation for this struct was generated from the following files:

- iir/ChebyshevI.h
- iir/ChebyshevI.cpp

6.71 Iir::ChebyshevII::LowShelfBase Struct Reference

Inheritance diagram for Iir::ChebyshevII::LowShelfBase:


Iir::Cascade
Iir::PoleFilterBase2
Iir::PoleFilterBase< AnalogLowShelf >
Iir::ChebyshevII::LowShelfBase

Additional Inherited Members

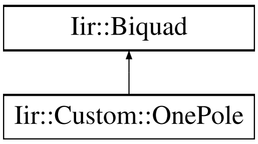
The documentation for this struct was generated from the following files:

- iir/ChebyshevII.h
- iir/ChebyshevII.cpp

6.72 Iir::Custom::OnePole Struct Reference

```
#include <Custom.h>
```

Inheritance diagram for Iir::Custom::OnePole:



Additional Inherited Members

6.72.1 Detailed Description

Setting up a filter with with one real pole, real zero and scale it by the scale factor

Parameters

scale	Scale the FIR coefficients by this factor
pole	Position of the pole on the real axis
zero	Position of the zero on the real axis

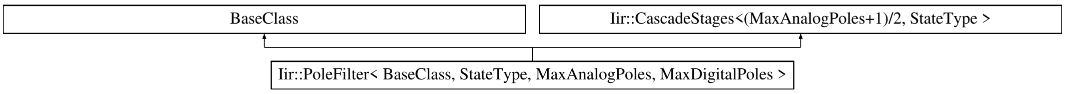
The documentation for this struct was generated from the following files:

- iir/Custom.h
- iir/Custom.cpp

6.73 Iir::PoleFilter< BaseClass, StateType, MaxAnalogPoles, MaxDigitalPoles > Struct Template Reference

```
#include <PoleFilter.h>
```

Inheritance diagram for Iir::PoleFilter< BaseClass, StateType, MaxAnalogPoles, MaxDigitalPoles >:


BaseClass
Iir::CascadeStages<(MaxAnalogPoles+1)/2, StateType >
Iir::PoleFilter< BaseClass, StateType, MaxAnalogPoles, MaxDigitalPoles >

Additional Inherited Members

6.73.1 Detailed Description

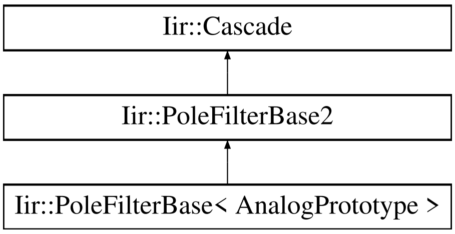
template<class BaseClass, class StateType, int MaxAnalogPoles, int MaxDigitalPoles = MaxAnalogPoles>
struct Iir::PoleFilter< BaseClass, StateType, MaxAnalogPoles, MaxDigitalPoles >

Storage for pole filters
The documentation for this struct was generated from the following file:

- iir/PoleFilter.h

6.74 Iir::PoleFilterBase< AnalogPrototype > Class Template Reference

`#include <PoleFilter.h>`
Inheritance diagram for Iir::PoleFilterBase< AnalogPrototype >:



Additional Inherited Members

6.74.1 Detailed Description

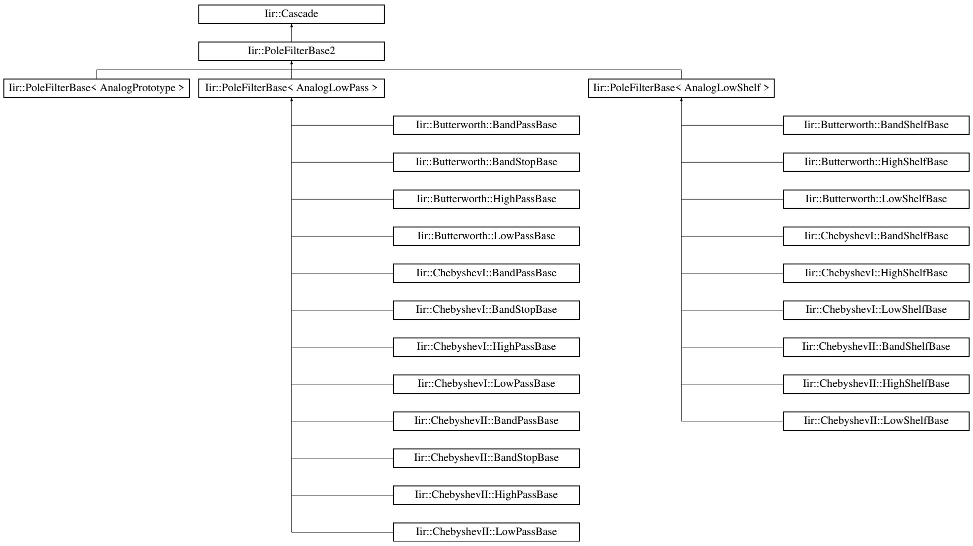
template<class AnalogPrototype>
class Iir::PoleFilterBase< AnalogPrototype >

Serves a container to hold the analog prototype and the digital pole/zero layout.
The documentation for this class was generated from the following file:

- iir/PoleFilter.h

6.75 Iir::PoleFilterBase2 Class Reference

`#include <PoleFilter.h>`
Inheritance diagram for Iir::PoleFilterBase2:


Iir::Cascade
Iir::PoleFilterBase2
Iir::PoleFilterBase< AnalogPrototype >
Iir::PoleFilterBase< AnalogLowPass >
Iir::PoleFilterBase< AnalogLowShelf >
Iir::Butterworth::BandPassBase
Iir::Butterworth::BandStopBase
Iir::Butterworth::HighPassBase
Iir::Butterworth::LowPassBase
Iir::ChebyshevI::BandPassBase
Iir::ChebyshevI::BandStopBase
Iir::ChebyshevI::HighPassBase
Iir::ChebyshevI::LowPassBase
Iir::ChebyshevII::BandPassBase
Iir::ChebyshevII::BandStopBase
Iir::ChebyshevII::HighPassBase
Iir::ChebyshevII::LowPassBase
Iir::Butterworth::BandShelfBase
Iir::Butterworth::HighShelfBase
Iir::Butterworth::LowShelfBase
Iir::ChebyshevI::BandShelfBase
Iir::ChebyshevI::HighShelfBase
Iir::ChebyshevI::LowShelfBase
Iir::ChebyshevII::BandShelfBase
Iir::ChebyshevII::HighShelfBase
Iir::ChebyshevII::LowShelfBase

Additional Inherited Members

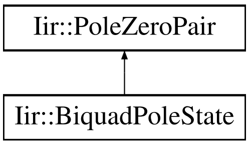
6.75.1 Detailed Description

Factored implementations to reduce template instantiations
The documentation for this class was generated from the following file:

- iir/PoleFilter.h

6.76 Iir::PoleZeroPair Struct Reference

`#include <Types.h>`
Inheritance diagram for Iir::PoleZeroPair:



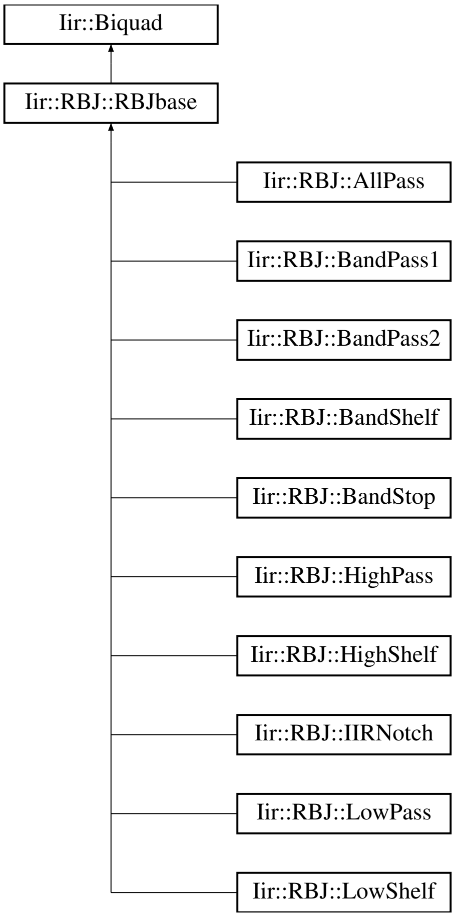
6.76.1 Detailed Description

A pair of pole/zeros. This fits in a biquad (but is missing the gain)
The documentation for this struct was generated from the following file:

- iir/Types.h

6.77 Iir::RBJ::RBJbase Struct Reference

`#include <RBJ.h>`
Inheritance diagram for Iir::RBJ::RBJbase:



Public Member Functions

- template<typename Sample >
  Sample filter (Sample s)

  filter operation
- void reset ()

  resets the delay lines to zero
- const DirectFormI & getState ()

  gets the delay lines (=state) of the filter

6.77.1 Detailed Description

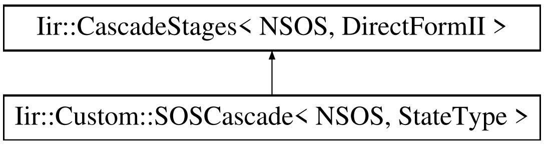
The base class of all RBJ filters
The documentation for this struct was generated from the following file:

- iir/RBJ.h

6.78 Iir::Custom::SOSCascade< NSOS, StateType > Struct Template Reference

```
#include <Custom.h>
```

Inheritance diagram for Iir::Custom::SOSCascade< NSOS, StateType >:


Iir::CascadeStages< NSOS, DirectFormII >
Iir::Custom::SOSCascade< NSOS, StateType >

Public Member Functions

- SOSCascade ()
- SOSCascade (const double(&sosCoefficients)[NSOS][6])
- void setup (const double(&sosCoefficients)[NSOS][6])

6.78.1 Detailed Description

template<int NSOS, class StateType = DirectFormII>
struct Iir::Custom::SOSCascade< NSOS, StateType >

A custom cascade of 2nd order (SOS / biquads) filters.

Parameters

NSOS	The number of 2nd order filters / biquads.
StateType	The filter topology: DirectFormI, DirectFormII, ...

6.78.2 Constructor & Destructor Documentation

6.78.2.1 SOSCascade() [1/2]

```
template<int NSOS, class StateType = DirectFormII>
Iir::Custom::SOSCascade< NSOS, StateType >::SOSCascade ( )
```

Default constructor which creates a unity gain filter of NSOS biquads. Set the filter coefficients later with the setup() method.

6.78.2.2 SOSCascade() [2/2]

```
template<int NSOS, class StateType = DirectFormII>
Iir::Custom::SOSCascade< NSOS, StateType >::SOSCascade (
            const double(&) sosCoefficients[NSOS][6] )  [inline]
```

Python scipy.signal-friendly setting of coefficients. Initialises the coefficients of the whole chain of biquads / SOS. The argument is a 2D array where the 1st dimension holds an array of 2nd order biquad / SOS coefficients. The six SOS coefficients are ordered "Python" style with first the FIR coefficients (B) and then the IIR coefficients (A). The 2D const double array needs to have exactly the size [NSOS][6].

Parameters

sosCoefficients	2D array Python style sos[NSOS][6]. Indexing: 0-2: FIR-, 3-5: IIR-coefficients.

6.78.3 Member Function Documentation

6.78.3.1 setup()

```
template<int NSOS, class StateType = DirectFormII>
void Iir::Custom::SOSCascade< NSOS, StateType >::setup (
            const double(&) sosCoefficients[NSOS][6] )  [inline]
```

Python scipy.signal-friendly setting of coefficients. Sets the coefficients of the whole chain of biquads / SOS. The argument is a 2D array where the 1st dimension holds an array of 2nd order biquad / SOS coefficients. The six SOS coefficients are ordered "Python" style with first the FIR coefficients (B) and then the IIR coefficients (A). The 2D const double array needs to have exactly the size [NSOS][6].

Parameters

sosCoefficients	2D array Python style sos[NSOS][6]. Indexing: 0-2: FIR-, 3-5: IIR-coefficients.

The documentation for this struct was generated from the following file:

- iir/Custom.h

6.79 Iir::Cascade::Storage Struct Reference

```
#include <Cascade.h>
```

Public Member Functions

- Storage (int maxStages_, Biquad ∗const stageArray_)

6.79.1 Detailed Description

Pointer to an array of Biquads

6.79.2 Constructor & Destructor Documentation

6.79.2.1 Storage()

```
Iir::Cascade::Storage::Storage (
        int maxStages_,
        Biquad *const stageArray_ )  [inline]
```

Copy-constructor which receives the pointer to the Biquad array and the number of Biquads

Parameters

*max↩ Stages_*	Number of biquads
*stage↩ Array_*	The array of the Biquads

The documentation for this struct was generated from the following file:

- iir/Cascade.h

6.80 Iir::TransposedDirectFormII Class Reference

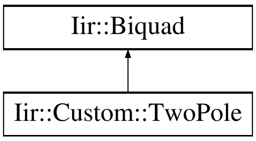
The documentation for this class was generated from the following file:

- iir/State.h

6.81 Iir::Custom::TwoPole Struct Reference

```
#include <Custom.h>
```

Inheritance diagram for Iir::Custom::TwoPole:



Additional Inherited Members

6.81.1 Detailed Description

Set a pole/zero pair in polar coordinates and scale the FIR filter coefficients

Parameters

poleRho	Radius of the pole
poleTheta	Angle of the pole
zeroRho	Radius of the zero
zeroTheta	Angle of the zero

The documentation for this struct was generated from the following files:

- iir/Custom.h
- iir/Custom.cpp

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