freqz

Compute the frequency response of quantized filters

Syntax

```
[h,w] = freqz(hq,n)
h = freqz(hq,w)
[h,w] = freqz(hq,n,'whole')
[h,w,units,href] = freqz(hq,...)
[h,f] = freqz(hq,n,fs)
h = freqz(hq,f,fs)
[h,f] = freqz(hq,n,'whole',fs)
[h,f,s] = freqz(hq,...)
[h,f,units,href] = freqz(hq,...,fs)
freqz(hq,...)
```

Description

`[h,w] = freqz(hq,n)` returns the frequency response vector `h` and the corresponding frequency vector `w` for the quantized filter `hq`. `freqz` uses the transfer function associated with the quantized filter to calculate the frequency response of the filter. The vectors `h` and `w` are both of length `n`. The frequency vector w has values ranging from 0 to π radians per sample. If you do not specify the integer `n`, or you specify it as the empty vector `[]`, the frequency response is calculated using the default value of 512 samples.

`h = freqz(hq,w)` returns the frequency response vector `h` calculated at the frequencies (in radians per sample) supplied by the vector `w`. The vector `w` can have any length.

`[h,w] = freqz(hq,n,'whole')` uses `n` sample points around the entire unit circle to calculate the frequency response. Frequency vector w has length `n` and values ranging from 0 to 2π radians per sample.

`[h,w,units,href] = freqz(hq,...)` returns the optional string argument `units`, specifying the units for the frequency vector `w`. The string returned in `units` is `'rad/sample'`, denoting radians per sample. The optional output argument `href` is the frequency response of the transfer function associated with the reference filter used to specify the quantized filter `hq`.

`[h,f] = freqz(hq,n,fs)` returns the frequency response vector `h` and the corresponding frequency vector `f` for the quantized filter `hq`. The vectors `h` and f are both of length `n`. The frequency response calculation uses the sampling frequency specified by the scalar `fs` (in Hz). The frequency vector f has values ranging from 0 to (`fs/2)` Hz.

`h = freqz(hq,f,fs)` returns the frequency response vector `h` calculated at the frequencies (in Hz) supplied in the vector `f`. Vector `f` can be any length.

`[h,f] = freqz(hq,n,'whole',fs)` uses `n` points around the entire unit circle to calculate the frequency response. Frequency vector f has length `n` and has values ranging from 0 to `fs` Hz.

`[h,f,s] = freqz(hq,...)` returns the structure `s` with the following fields:

- `s.xunits`--a string specifying the frequency axis units. The contents of `s.xunits` can be one of the following:
  - `'rad/sample'` (default)
  - `'Hz'`
  - `'kHz'`
  - `'MHz'`
  - `'GHz'`
  - A user-specified string
- `s.yunits`--a string specifying the vertical axis units. The contents of `s.yunits` can be one of the following:
  - `'dB'` (default)
  - `'linear'`
  - `'squared'`

- `s.plot`--a string specifying the type of plot to produce. The contents of `s.plot` can be one of the following:
  - `'both'` (default)
  - `'mag'`
  - `'phase'`

`[h,f,units,href] = freqz(hq,...,fs)` returns the optional MATLAB structure `units`, that `freqzplot` uses for plotting. The string returned in `units` is `'Hz'` for hertz. The optional output argument `href` is the frequency response of the transfer function associated with the reference filter used to specify the quantized filter `hq`.

`freqz(hq,...)` plots the magnitude and unwrapped phase of the frequency response of the quantized filter `hq` in the current figure window.

Remarks

There are several ways of analyzing the frequency response of quantized filters. `freqz` accounts for quantization effects in the filter coefficients, but does not account for quantization effects in filtering arithmetic. To account for the quantization effects in filtering arithmetic, refer to function `nlm`.

Algorithm

`freqz` calculates the frequency response for a quantized filter from the filter transfer function *Hq*(*z*). The complex-valued frequency response is calculated by evaluating $Hq(e^{j\omega})$ at discrete values of *w* specified by the syntax you use. The integer input argument `n` determines the number of equally-spaced points around the upper half of the unit circle at which `freqz` evaluates the frequency response. The frequency ranges from 0 to π radians per sample when you do not supply a sampling frequency as an input argument. When you supply the scalar sampling frequency `fs` as an input argument to `freqz`, the frequency ranges from 0 to `fs`/2 Hz.

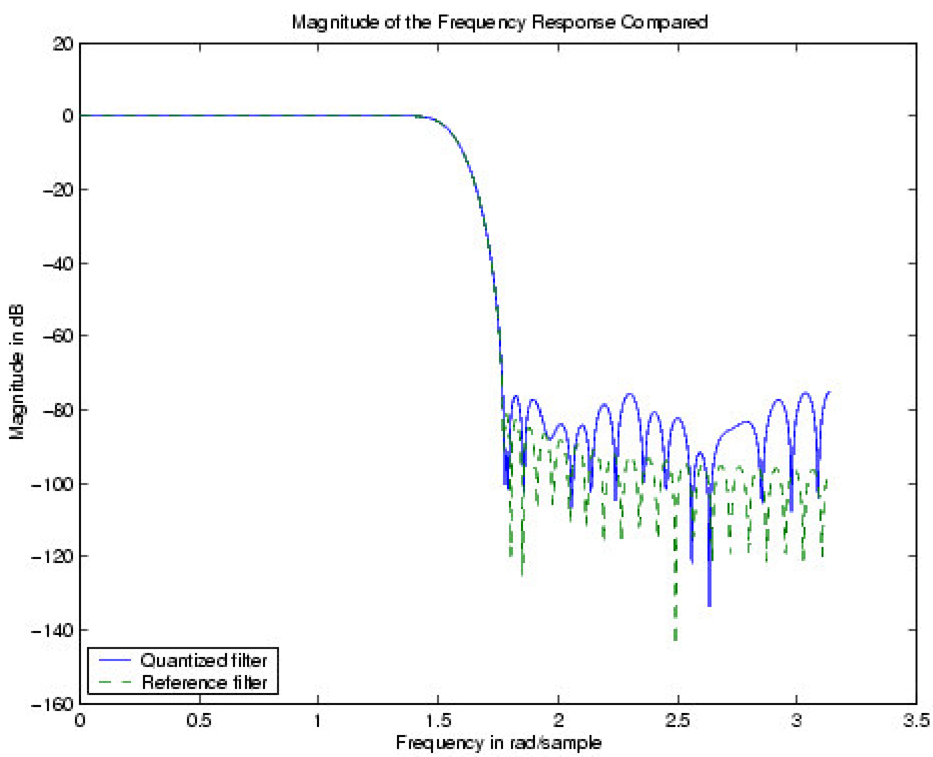
To calculate the transfer function associated with a quantized filter, `freqz` uses the values of the `QuantizedCoefficients` and `FilterStructure` properties.

When you include the optional output argument `href` in the command, `freqz` uses the value of the `ReferenceCoefficients` property to calculate the frequency response of the reference filter transfer function.

Examples

Plot the estimated frequency response of a quantized filter.

```
b = fir1(80,0.5,kaiser(81,8));
hq = qfilt('fir',{b});
[h,w,units,href] = freqz(hq);
plot(w,20 * log10(abs(h)),'-',w,20 * log10(abs(href)),'--
legend('Quantized filter','Reference filter',3)
xlabel('Frequency in rad/sample')
ylabel('Magnitude in dB')
title('Magnitude of the Frequency Response Compared')
```



See Also

`qfilt`

`fvtool` in your Signal Processing Toolbox documentation