1 Theory, assumed state of knowledge

Lecture (CE II/Script): Chaper 1, 3; especially sections 1.4 and 3.3: BP signals and BP systems in equivalent lowpass domain, transmission with linear modulation methods over BP channels

2 What is shown?

The *BP-LP transformation* is an important theoretical concept for modeling digital and analog transmissions. It will be examined here with signals chosen from a list of example functions.

The plotbox shows at the left the signal (or time function) and at the right the correponding spectrum (or Fourier transform of the signal). The duration of the signal can be variied with the gui button “Var” (left/right mouse button). This enables to demonstrate the relation *short duration - wide spectrum* and vice versa. With the button “BP domain” the correponding BP signal and its spectrum is shown.

For the cosine and complex exponential signals the frequency can be variied. Note the transition from positive to negative frequencies. A further trial (one m-file) is concerned with the relation *even/odd time functions - spectra with real/imaginary part only*. A rect impulse can be variied with the “Var” button such that all cases from even to odd can be seen.

In another trial even/odd spectra of equivalent lowpass signals can be taken as a starting point. It can be seen that the equivalent lowpass signals vary between pure real-valued and pure imaginary-valued. With this it can be stressed, that by a shift of the equivalent lowpass spectrum and a symmetrical completion a real-valued BP signal results, which contains all information about the real and imaginary part of the equivalent lowpass signal. With this it becomes possible to transmit two independent signals over one BP channel.

In time domain shift and symmetrical completion correspond to a multiplication with a complex exponential function and taking the real part.

3 What is demonstrated?

The aim of this demo is deepen the understanding of the Fourier transform by examples, and especially to visualize the concept of BP-LP transform with its ability to describe BP signals and systems by equivalent LP signals and systems. Important for that is the relation *even/odd time functions - spectra with real/imaginary part only* and its counterpart for spectra and time functions. With this it should become clear directly, why symmetric BP signals give real-valued equivalent lowpass signals, and non-symmetric BP signals complex-valued equivalent lowpass signals.