# UWB laboratory work No.3

*"Human breathing monitoring using UWB device"*

The goals of the work are acquaintance with accurate range measurements using UWB technology, learning properties of noise-like UWB signals as well as becoming acquainted with penetration capabilities of UWB signals. So-called M-sequence signal is a periodic pseudo-random sequence of pulses. This signal is unique in the sense that its auto-correlation does not have side-lobes. Theoretically it allows to measure the range based on time delay for the return trip very accurately.

You will use an M-sequence radar for through-wall monitoring of a person's breathing.

## A. Measurement set-up

Study the measurement set-up. Draw the basic block diagram of the system. Pay attention to how the basic blocks are connected.

## B. Breathing monitoring

Determine the parameters of human breathing (periodicity of breathing and amplitude of the human chest movements) using the M-sequence signals.

1. Acquire the backscattered signals from a breathing person through the laboratory wall.

*In the post-processing stage:*

2. Separate in time the signals reflected from the air-wall interfaces from the reflections from the human body. Window functions can be used.
3. Perform background subtraction and remove stationary targets. Compare the width of the reflection from the wall with that of the ambiguity function.
4. Select the range bin where you can best observe the breathing motion. For the selected range, plot the breathing motion magnitude versus slow time.
5. Determine the breathing frequency by means of Fourier Transform.
6. (Extra task) From the stationary signals, determine the wall thickness.

## C. UWB ambiguity function

You will be provided with the radar's M-sequence signal.

7. Compute and plot the spectrum of the acquired signal. Compute the auto-correlation and the ambiguity function of the waveform.

REFERENCES for UWB ambiguity function:

Wideband Ambiguity Function of Broadband Signals, Zhen-biao Lin,30, Nov.1987 Wavelets and Wideband Correlation Processing, Lora G. Weiss, Jan. 1994.

## D. Prepare your report

8. Make drawings of your measurement schemes and explain the measurement settings.
9. For each task demonstrate the measured pulses & their spectra and processing results by showing their graphical representations.
10. Explain the results obtained.