

TELEMED ULTRASOUND FOR SCIENCE & RESEARCH

RF Data Access

RF DATA ACCESS

Majority of the commercial ultrasound systems are closed for the researchers and do not provide access to raw RF signals.

A normal clinical ultrasound user only has access to the ultrasound data in its final processed form, typically B-Mode images, and have limited access to the processing parameters that can be modified.

This means that large part of information which is embedded in raw or radio frequency signal (RF) representing backscattered ultrasound waves is thrown away.

Greyscale ultrasound images, though useful for research, cannot be processed back into native RF form, whereas an RF signal, through envelope detection and compression can be processed into a standard ultrasound B-mode image.

RF signals carry valuable information about acoustic wave and tissue interactions and can be employed for the development of new diagnostic methods.

The information extracted from RF signals, could be successfully used for a variety of purposes and is one aspect that is becoming increasingly important in ultrasound research, including image processing, tissue characterization, development of quantitative ultrasound imaging, beamforming techniques and other signal processing applications.

RF Data for research is used to develop parameterization algorithms for backscattered ultrasound RF signals received from tissues and to provide supplementary B-scan parametric maps.

TELEMED offers advanced research tools for scientists working in biomedical ultrasound field which allows to analyze RF data acquired by the new ArtUs, a PC based open architecture system which allows not only to acquire high quality B-Mode and Color doppler images but provides users with full control over imaging parameters and the acquisition of multiple data types.

The RF DATA tools open new possibilities for:

Engineering viewpoint	Clinical practice viewpoint
Developments of novel ultrasonic quantitative tissue characterisation methods	Derivation of novel biomarkers for: recognition, characterisation and differentiation of various lesions and assessment of treatment (i.e. thermal ablation efficiency, sonoporation)
Investigation of acoustic properties of tissue and tissue mimicking materials	Investigation of acoustic properties of tissue and tissue mimicking materials
Developments of novel parametric imaging techniques	New sources of contrast for imaging of various lesions (tumors, tissue fibrosis, atherosclerotic plaques and much more)
Creation of advanced digital image processing algorithms for speckle reduction, and image enhancement	Better quality of ultrasound diagnostic images more appropriate for visual expert's evaluation

RF DATA ACCESS Description

The ArtUs allows the collection of ultrasound data acquisition and supports custom software and programs which can be executed directly eliminating the need for extra hardware that is often required for data collection and analysis.

In RF mode a standard B-Mode image is displayed, along with an RF spectrum.

An important feature of this acquisition method is the fact that corresponding ultrasound images can be stored alongside the RF data collected. This provides an important reference which allows users to verify the captured data prior to processing the RF data itself.

Telemed provides a research package that includes a real-time acquisition software, RF mode, and SDK (Software Development Kit) for client applications.

The research platform offers access to RF Data and provides adjustable parameters to control filtering, envelope detection, and compression, making it possible for in depth data analysis.

The research package is implemented in the MATLAB® (MathWorks, Inc., Natick, Massachusetts) environment and contains graphical user interfaces (Figs. 1-5) which allows to import and review annotated RF data and collection of scripts illustrating conventional RF signal processing steps, which are typically used in the B mode image formation engine.

With flexible control of the complete ultrasound signal path in an open architecture, the ArtUs is one of the most advanced research-driven ultrasound system in the market.

Due to these advantages, many universities and research institutes are using the ArtUs to test and implement their customized solutions for different applications.

RF Data Tool allows to observe in real-time 2 streams, B+RF.
Also tool allows to set scanning parameters, define area of interest, record RF Data to disc and etc., C++ application.

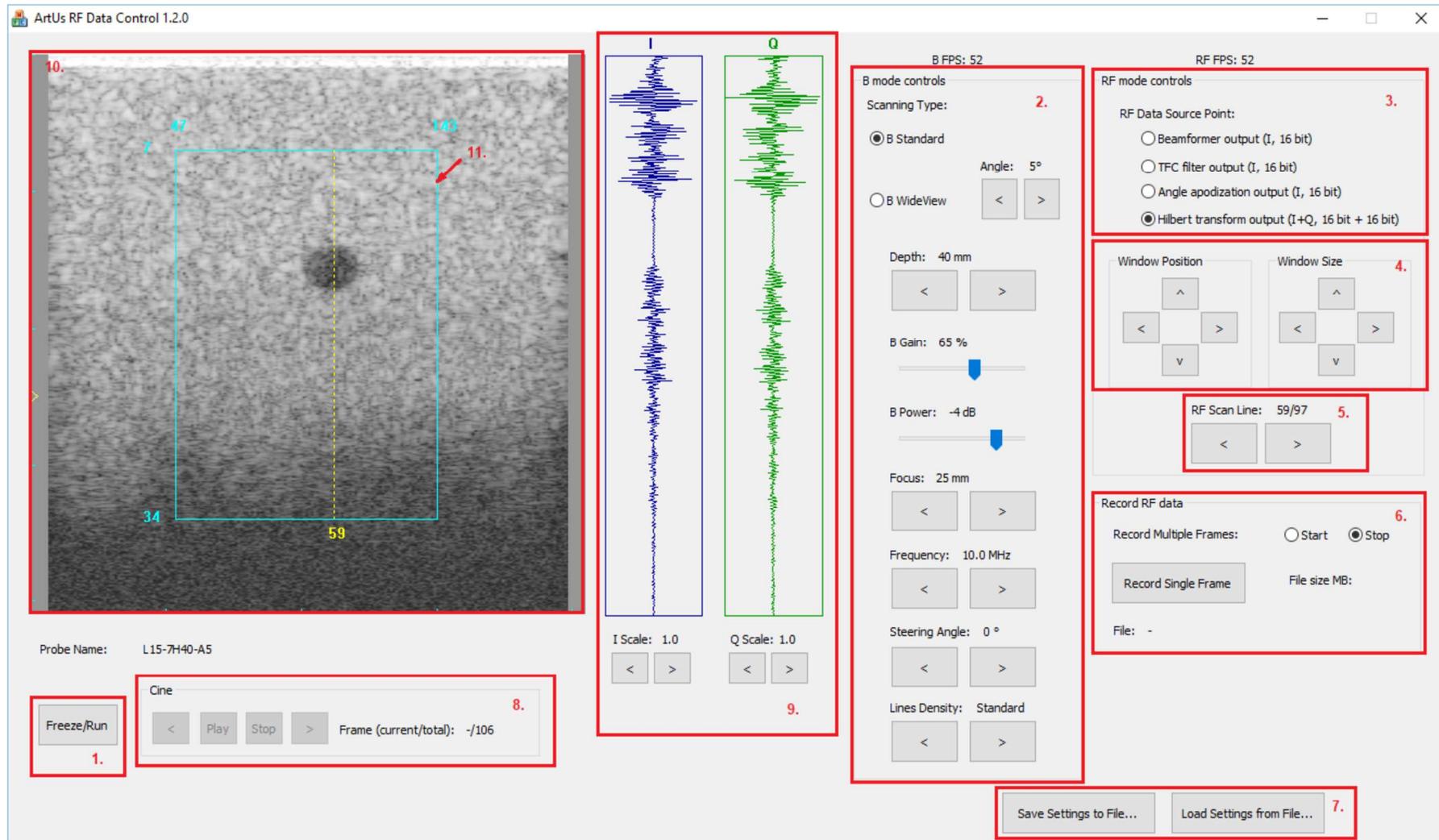


Fig. 1. RF Data Control tool

RF Data Tool allows to import into MATLAB and review recorded RF data and the main data acquisition parameters. MATLAB tool.

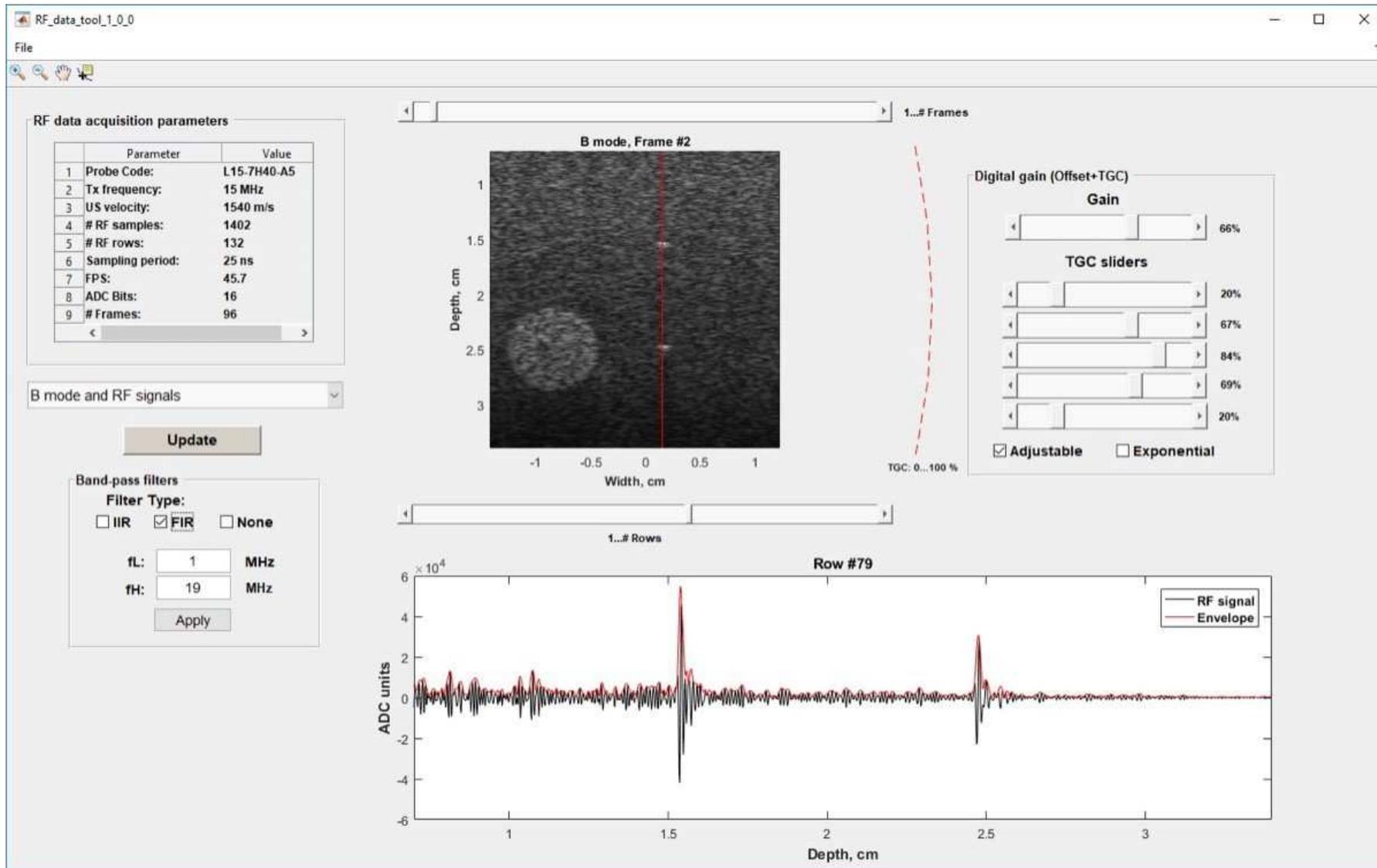


Fig. 2. RF Data tool

RF Data Tool allows to filter acquired RF signals and to observe how the filtering influence the final ultrasonic B mode image. Various filters could be designed by using GUI. MATLAB tool.

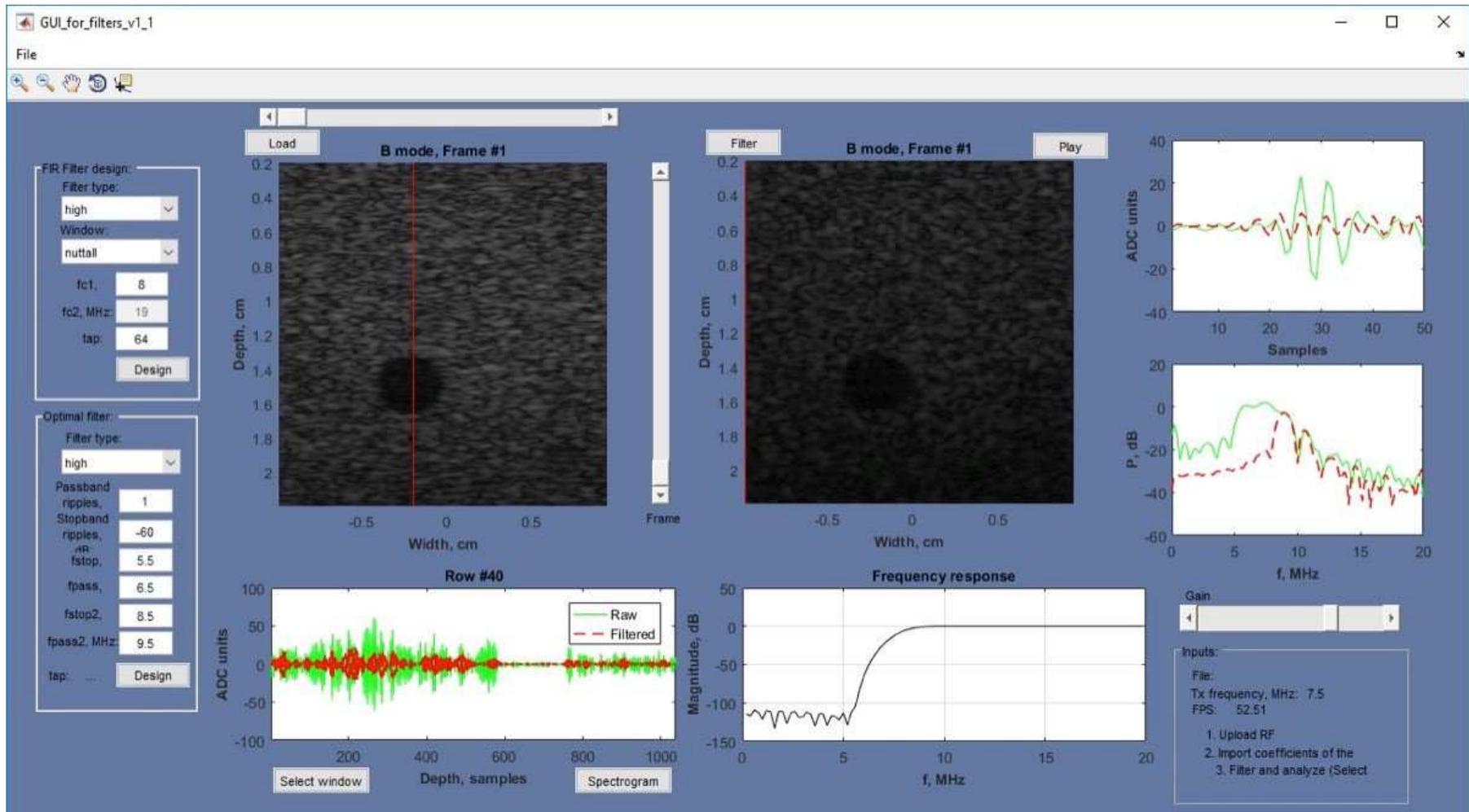


Fig. 3. Filters Analysis tool

The GUI allows to adjust dynamic range reduction curve and to observe how it affects final B mode image. MATLAB tool.

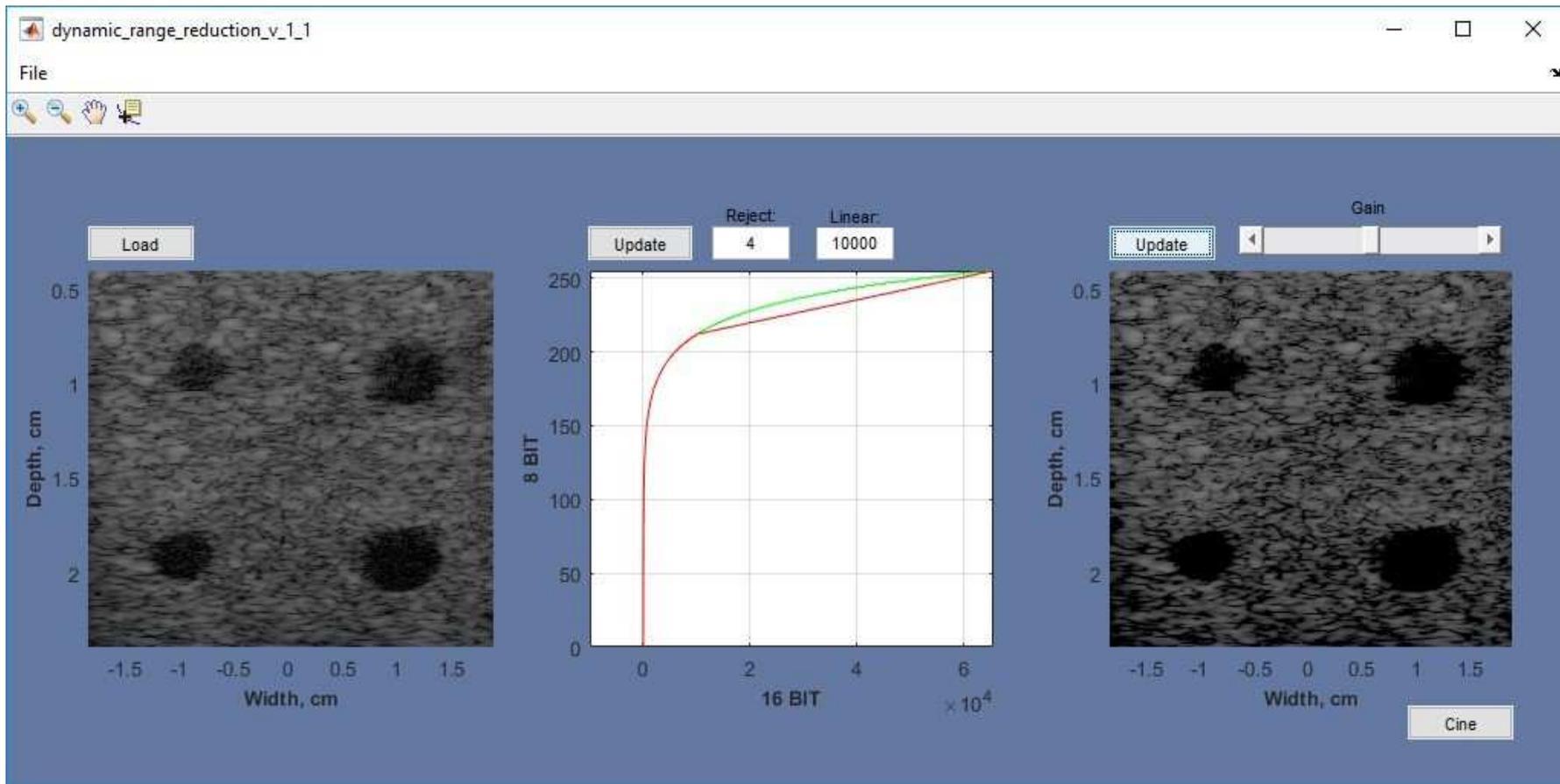


Fig. 4. Dynamic Range control tool

The GUI allows to filter speckle noises. MATLAB tool.

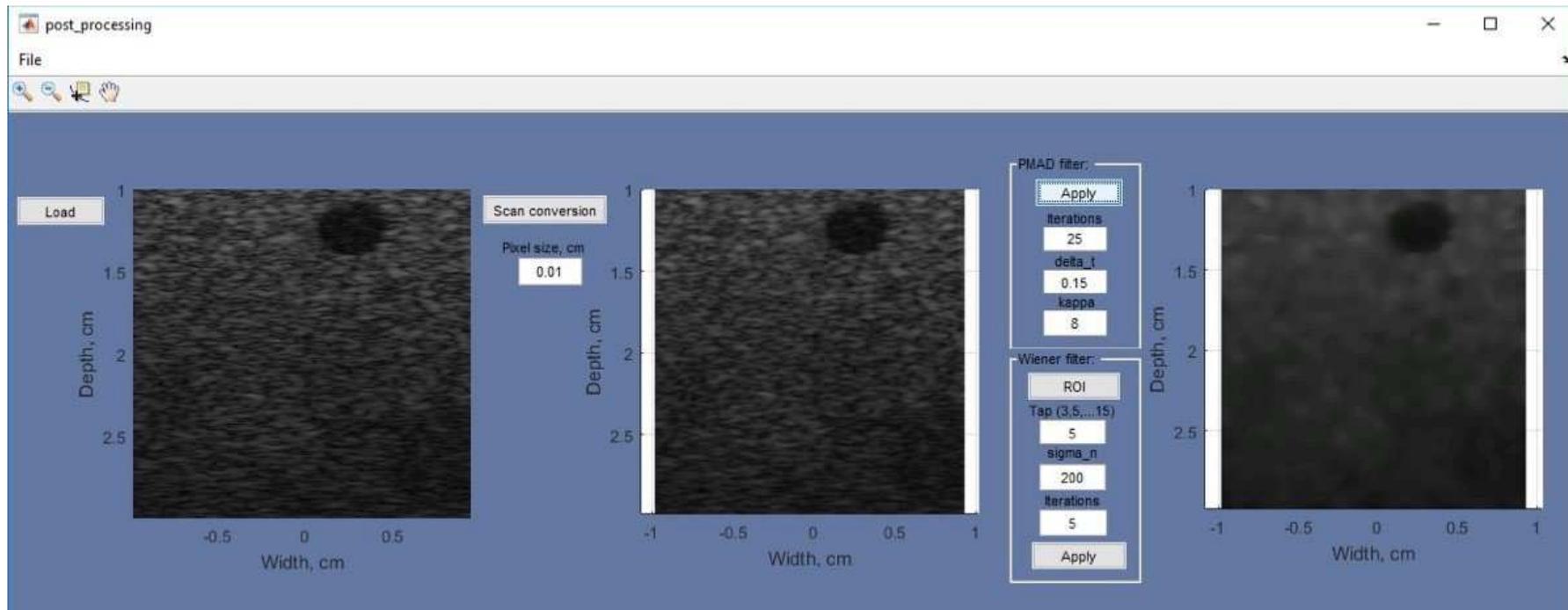


Fig. 5. Postprocessing control tool

The GUI allows to load and view RF data. PYTHON tool.

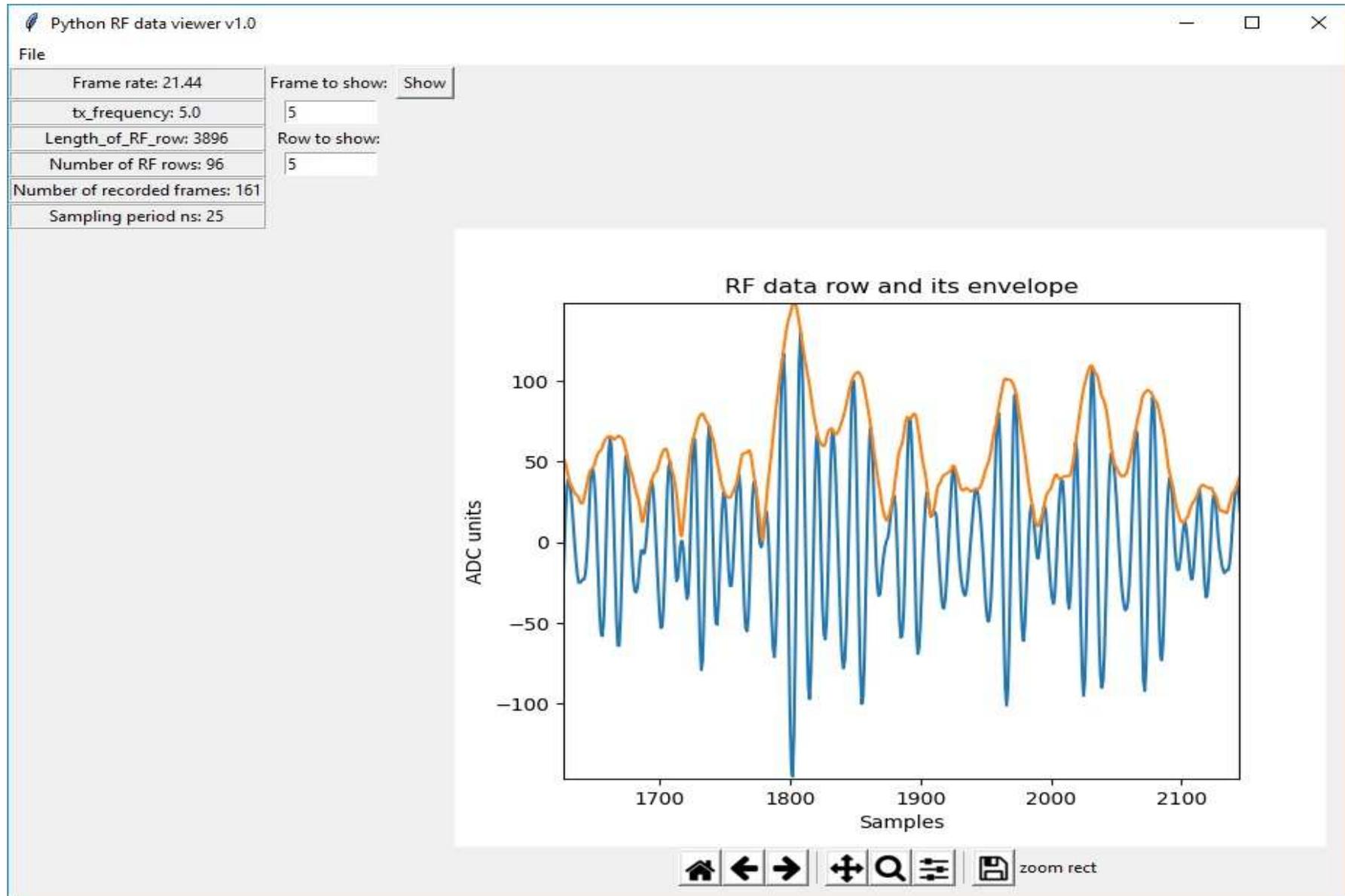


Fig. 6. RF Viewer tool

INFO ABOUT RF DATA

Digital RF-Data access allows users to acquire and save the RF (radio frequency) data from the high frequency ultrasound signal. Ultrasound transducers convert electrical signals into pressure waves which are transmitted into the tissue (transmit pulse). Differences in tissue density and speed of sound cause reflection and scattering of the transmit pulses, such that a portion of the sound waves reflect back towards the transducer. When these waves reach the transducer, they are converted into a receive electrical signal. The received signal is composed of multiple reflections which combine together to form an interference pattern known as speckle. This receive signal is commonly referred to as RF data. The analog received signal is first amplified, then sampled (converted into a digital signal), and then processed.

Available Data Formats:

- IQ Data** Quadrature sampling is used to convert the processed signal into two digital quadrature signals, the I (in-phase) and the Q (quadrature), referred as the IQ signal. Beamforming is then performed on the IQ signal, followed by further processing to finally generate the displayed images.
- RF Data** A digital representation of the RF signal can be reconstructed from the IQ data. This is accomplished through interpolation of the I and Q signals, and subsequent multiplication by a complex exponential.
- Raw Image Data** IQ data can be envelope-detected, log-compressed, and subsequently exported. This envelope format, referred to on the ArtUs Systems as "RAW", is a useful way of accessing image data that correlates exactly to what is seen on the system display. Image data in this format are readily available for offline image processing applications.

