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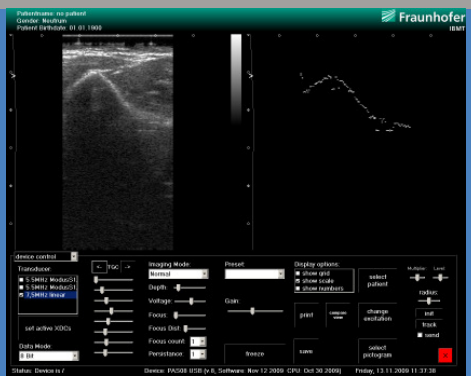

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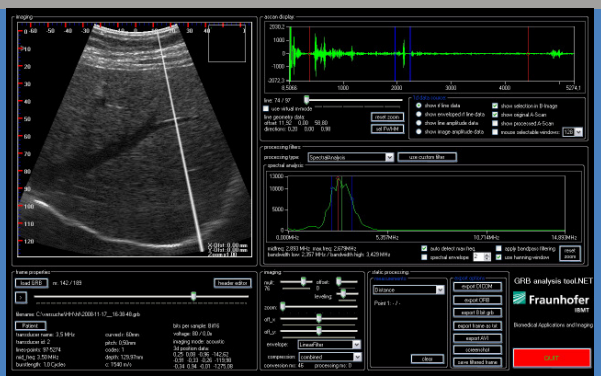

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1 *Online Analysis Signal Processing (online bone detection filtering, dual view)*

2 *Offline Analysis Tool for signal processing*

Ultrasound Research RF Data Analysis Software and Framework

Software in Ultrasound Research

The development of new procedures and techniques using ultrasound imaging requires the use of measured raw radiofrequent ultrasound data. Looking at commercial platformsthis is currently only available with limited access to system parameters and usability. We present a complete ultrasound research package including a software architecture based on the scalable DiPhAS multichannel ultrasound research hardware with free access to all system parameters for beamforming and signal-/image-processing, including multicore and GPU accelerated 2d scanconversion, 3d volume reconstruction and raw single channel data access. The scalable hardware system and the software implementation is used in medical products with certification for clinical use and utilizes a unique closed loop control for implementation of new algorithms and procedures without losing a clinical validation.

Requirements on a research software

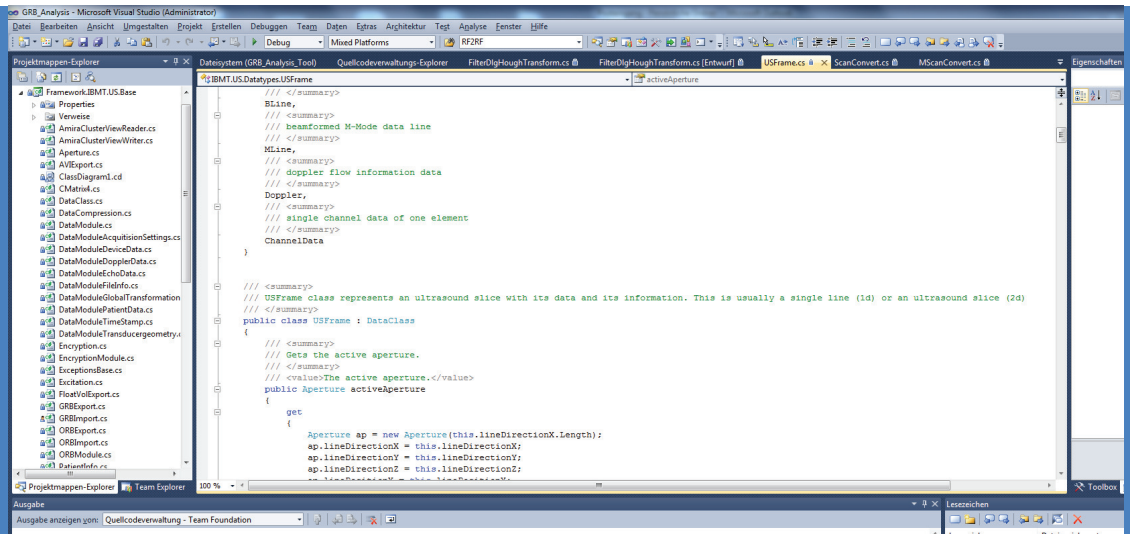
Working on ultrasound research for 2d-/3d-measurement and imaging requires the use of radiofrequent ultrasound data and open interfaces for hardware and software including free programmability of beamforming parameters and scanning modes. The process of developing new imaging procedures is an iterative process that requires flexible adaptations to both software implementations of signal processing algorithms and hardware setup and features. Vendors of commercial diagnostic ultrasound systems usually do not provide access to measured raw data and interfaces in all devices for every buyer andlimit the access to few research topics and selected research groups. Furthermore the access is only available for the top end and pricy models and there is a lack of medical approval as a diagnostic imaging system as soon as the devices are used in RF-data research mode.

Fraunhofer-Institute for Biomedical Engineering IBMT

Ensheimer Str. 48
66386St.Ingbert
Germany

Contact
Steffen H.Tretbar
Telefon +49 6894980-226
steffen.tretbar@ibmt.fraunhofer.de

www.ibmt.fraunhofer.de



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Software Overview

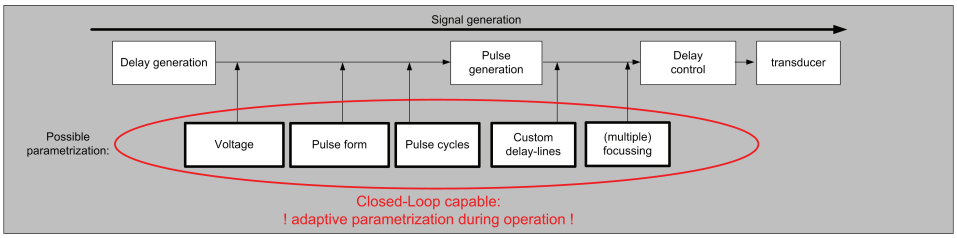
The use of comprehensive software components for a research hardware is neccessary to help the developers to focus on the development of new techniques and not the handling of common problems in ultrasound imaging.

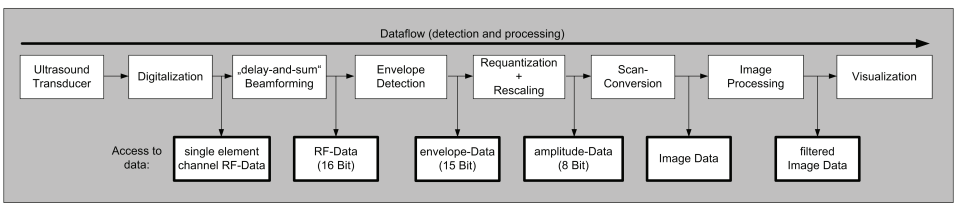
For this use we designed a portable C++ and C# (Microsoft .NET framework) software architecture including imaging and analysis for both online and offline tools. Nevertheless the programming of the framework and its interfaces is easy to learn and can be adapted to all additional tasks.

Included in the software framework are routines for data acquisition via USB, signal processing (i.e. logarithmic compressions, envelope detections, bone or tissue detection filters, channel-data to delay-and-sum-data reconstruction, scanconversion, 3d reconstruction..), image analysis and processing (i.e. speckle reduction imaging, measurements,..), data export (i.e. RF-raw data, images, videos, DICOM, text output for external analysis,..) and data import from different measurement systems in-house and externally. The algorithms support multi-core, multi-threaded or GPU accelerated (using OpenCL) system architectures and benefit from parallelization.

Support for 3d tracking systems to acquire and reconstruct volume datasets is implemented by position and orientation measurement for optical, mechanical and electromagnetical 3d-tracking systems (i.e. NDI Polaris, Spectra, Vicra, Microscribe, Ascension Flock of Birds,..).

The signal and image processing of this research platform provides a unique feature by the closed-loop device control that simplifies the development of new techniques and algorithms. Custom filters developed according to the filter software interfaces can control the beamforming and system parameters automatically conserving the medical certification for the important tests at clinical sites.





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All this is implemented using an open filter framework, open data structures, a plugin concept and the closed-loop control. Programming an implementation of a new filter algorithm for both online and offline processing can be developed during 5 minutes using templates for RF-based or image-based processing.

Figure 4 shows the possibilities of signal generation and data acquisition using the „DiPhAS" research platform and gives an overview over access to channel data, beamformed 16 bit RF-data, 8 bit amplitude data after envelope detection and logarithmic compression before scanconversion, image data after scanconversion and processed imaged data for use in the closed-loop control.

Our Offer

We offer an ultrasound research platform that consists of a scalable and freely programmable hardware platform combined with a software architecture for 2d and 3d imaging and measurement developed according to IEC 62304. The free access to channel data, RF-data and 8bit amplitude data together with a filter plug-in system that allows closed-loop control makes this system a unique research tool with the possibility of medical certification to implement and test new algorithms and procedures. The development of a commercial product based on the research done can be done easily which has been proven in several applications.

3 *Visual Studio Development Software for development of custom filters*

4 *Software interfaces and parameter access*