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A REAL TIME VISUALIZATION, ANALYSIS AND MANAGEMENT TOOLKIT FOR MULTI-PARAMETER, MULTI-STATIC WEATHER RADAR DATA

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1. INTRODUCTION

The DLR-TOOLKIT software environment is presented. It is designed to process polarimetric and Doppler weather radar data of POLDIRAD. Additionally it processes and integrates multiple BISTATIC Doppler radar receivers and the wind data measurements produced. In-situ flight data information as well as lightning data can be visualized simultaneously with the radar data. The large amount of information and radar-meteorological moments generated by the multi-polarization Doppler radar in conjunction with currently three bistatic radar receivers represents a great challenge for data processing with respect to performance and data quantity handling. The paper presents the software design criteria and the concept realized. This object oriented software environment and library is applicable and easily adapted to almost any weather sensor data to be analyzed and presented for scientific and quality monitoring purpose

2. GENERAL CONCEPT

Traditional programming and data management methods had to be extended by modern object-oriented (C++ class library) software modules that provide a flexible “toolbox” for

- Visualization in real time of any selected moment measured (PPI, RHI, A-scope, Ray-plots);
- Processing of measured moments - raw data- by (scientific) user designed algorithms (API) and visualization in real time;
- Product generation of DLR algorithms and display;
- Search, filtering, post-processing and flexible analysis of archived measurement data at selected meteorological events;
- User friendly graphical interface for data base access;
- Visualization with DEM (digital elevation model) underlay and static and dynamic (time-space coherent) vector overlays.

The development of the system resulted from a close co-operation between the DLR scientific users and the contracted company GAMIC, both having contributed their specific know-how and development methods.
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3. DESIGN METHODS

The design goal was to achieve a user-friendly analysis tool that handles existing –different- raw data formats and is open for new interfaces, algorithms and formats. To achieve this goal the C++ programming language in combination with the well known Qt class library from Trolltech AS Norway was choosen. Due to the modern concepts of the C++ language handling of radar data as well as the visualization of the data could be cleanly encapsulated. The toolkit provides low level C++ class objects for the data handling as well as high level objects like visualization windows (including over and underlay), file selection dialog, color legend editor etc.

To minimize the programming effort for the creation of a new product algorithm the toolkit provides so called 'modules'. These are high level classes that encapsulate all the needed functionality for loading of data, visualization and configuration of the numerous toolkit options. The creation of a new 'module' comes down to deriving from such a module class (e.g. PPI module) and implementation of the algorithm. In most cases the implementation of a **single function member** (the algorithm itself) is sufficient to create a fully functional module that provides sophisticated data visualization facilities as well as printing of the images and export of PNG images or Postscript files for documentation purposes.

This helps the scientist to concentrate on the algorithm. To facilitate the usage of the ”man-machine-interfaces“ (MMI's) provided by the toolkit a online help facility is included. It provides direct short descriptions of the MMI elements as well as a fully featured HTML based online help which can be browsed with the integrated help browser.

4. THE TOOLKIT MAIN FUNCTIONAL ELEMENTS

The modules are controlled by a separate program called 'Control Center'. Here the user can select the available modules and configure them according to his needs.

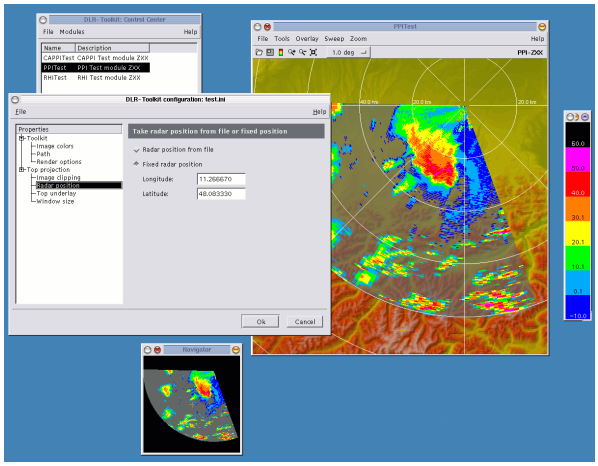

Fig.1 TOOLKIT Control Centre

Fig 1. shows the 'Control Center' together with a PPI module and the configuration dialog. Using the 'Control Center' gives the 'end user' a powerful but easy to use tool for visualization of radar data. Due to the library concept new product algorithms can easily be added. This open concept instead of a single program with limited functionality is the strength of the DLR Toolkit.

The visualization windows provide various interactive tools for data inspection as raw data zoom and specific information on the measured data as shown in fig.2.

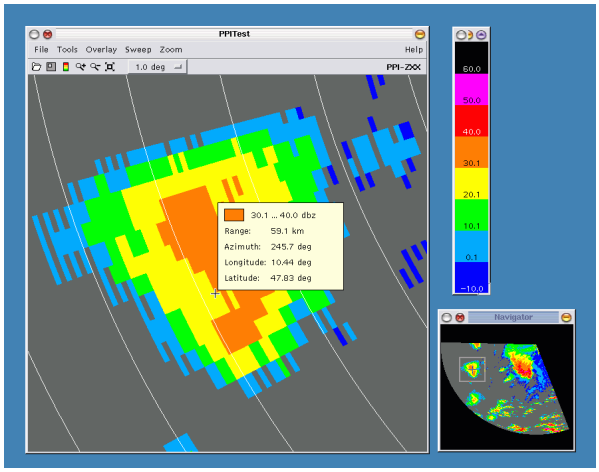

Fig.2 Interactive ZOOM Function

The radar images are rendered with high precision taking beam width and antenna position into account. This gives precise images of the measured data even if the positioning of the radar beam is influenced by high wind pressures on the antenna.

Color mapping of the images is controlled by the toolkit through highly configurable 'color legend objects'. The toolkit provides a editor dialog where one or more legends can be configured. The legends may have linear or a user defined mapping which can be easily created with some mouse-clicks. One may define several legends with different properties which is usefull for thresholding data in the images or to highlight specific phenomena. Fig. 3 shows the legend editor with some example color legends. It also shows the direct help facility giving a short explanation of the mapping area of the dialog.

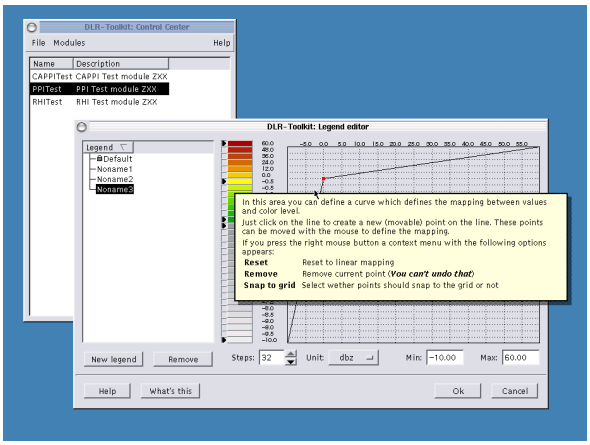

Fig.3 Interactive Legend Editor

In order to give easy access to the enormous amount of data at the DLR the toolkit provides a file selection dialog with a preview of the selected file as shown in Fig 4.

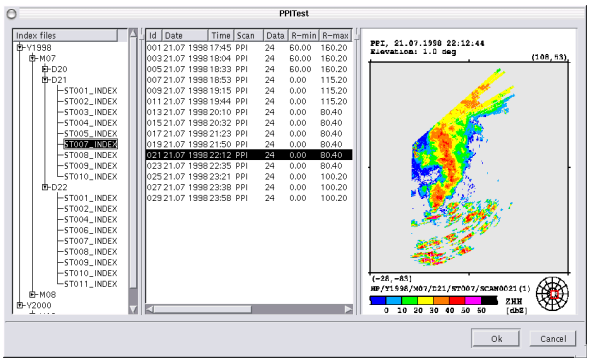

Fig. 4 File Preview Function

Besides the interactive facilities of the toolkit all modules can be used for batch processing of data by calling them at the command line. This empowers the user to create image sequences for animations or documentation purposes.

The toolkit provides C++ class objects for the following data types:

- Raw data from dual polarization doppler radar
- Raw data from bistatic receiver(s)
- Static longitude/latitude overlays
- Dynamic flash data
- Dynamic flight data for overlays
- Generic overlay for self defined overlays

Generic visualization modules are provided for:

- PPI
- PPI from bistatic radar
- CAPPI
- RHI
- Rangeplots

More modules will be developed within the next project phases.