Rack - a program for anomaly detection, product generation, and compositing

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Rack is a command-line program for processing weather radar data. It uses sweeps or volumes in ODIM HDF5 format as input and generates single-radar products as well as composite products. Rack provides anomaly detection and removal (AnDRe) functions which can be applied also independently from product generation. Rack also supports producing output in image formats and provides related utilities such as applying color palettes and transparency.

Rack is based on anomaly detection software developed in C for Unix/Linux and operated in the Finnish Meteorological Institute since 2001. Recent C++ development work has been also supported by the BALTRAD project, making the code publicly available under the GNU Lesser General Public License (LGPL). As external dependencies, Rack needs only HDF5, PNG and proj4 libraries which makes Rack a lightweight module for operational or research environments.

Due to Rack's background in anomaly detection, support for quality information has been one of the central features in design. Quality information is generated by the anomaly detectors; the information is further applied in anomaly removal stage and product generation. There are detectors for speckle noise, ships, biometeors (birds and insects) and emitter lines (electromagnetic interference).

Also basic products support quality information. For example, CAPPI uses quality in weighting the interpolation between two subsequent beams. Also the output contains quality information, reflecting the quality of input data and product geometry.

In dBZ composite products, there are several compositing principles: maximum, average, maximum-quality and quality weighted, including nearest-radar. In the computation, there are two alternative algorithms: a traditional backward (surjective) mapping and a forward (injective) mapping which is coarser but faster and suitable for on-demand services, for example. Internally, compositing uses a cumulative array from which the final intensities and qualities are extracted to the end product. The applied method also provides the radar count and standard deviation for each pixel.

This paper explains and illustrates the usage of Rack and discusses the design and speed of involved algorithms. Recent development work has focused on distributed compositing and ensuring full ODIM compatibility for European radar data.