C-Scope Radar System
X-Band Frequency Diversity

KONGSBERG

The C-Scope X-Band Frequency Diversity Radar System is the latest solution from Kongsberg Norcontrol IT for high performance VTS. It consists of a low noise, dual frequency transceiver set for the generation and reception of radar pulses at two distinct frequency bands within X-band, and a new Video Extractor and Tracker that processes the two video signals jointly for improved sea clutter reduction and increased probability of detection in critical VTS applications. Should one transceiver fail, or should dual frequency operation not be required during certain times, the system can revert to standard single-frequency operation with a redundant transceiver.

Features

The main features of the C-Scope X-Band FD Radar System can be summarised by the following:

- *Frequency diversity for improved signal-to-clutter ratio*
- *Magnetron-based transceivers at 8900 and 9375 MHz*
- *Solid state MOSFET (Metal Oxide Semiconductor Field Effect Transistor) electronic modulators*
- *Automatic fail-safe to and possibility of operation in single-transceiver configuration*
- *14-bit, 100-MHz sampling of the video signals*
- *Full range resolution at all ranges (sweep length limited only by PRF)*
- *High probability of detection*
- *Ability to discriminate between close targets*
- *Stable tracking and rapid manoeuvre detection*
- *Digital radar video generation including true raw video*

Transceivers

The transceivers are the low noise model RTM25X-M/VTS from Consilium Selesmar, tuned to 8900 and 9375 MHz. They are designed on the latest solid state technology, with MOSFET electronic modulators for the generation of well shaped pulses, outstanding dynamic range and extremely low noise figure.

- *Operating frequencies: 8900 MHz and 9375 MHz*
- *Peak power: 25 kW nominal*
- *Pulse length: 60 ns, 250 ns, 800 ns*
- *PRF (Pulse Repetition Frequency): 3000 Hz, 1500 Hz, 750 Hz*
- *Staggered PRF available as standard*
- *IF (Intermediate Frequency) amplifier: logarithmic*
- *IF dynamic range: 130 dB*
- *Overall noise figure: <3.5 dB nominal*
- *Image signal strength: <-60 dB nominal*
- *Spurious emissions: <-75 dB nominal*
- *Sector blanking: two sectors set at time of installation*
- *Options: different RF (Radio Frequency) and PRF sets*

Radar Interface

The radar interface has been redesigned to increase flexibility and robustness. The two analogue video signals are sampled with 14-bit analogue-to-digital converters at a rate of 100 MHz.

The digitized signals undergo CFAR (Constant False Alarm Rate) and other processing in a large FPGA (Field Programmable Gate Array), after which they are passed on to a dual-CPU computer for further analysis in software.

- *Analogue-to-digital conversion: 14-bit at 100 MHz*
- *Thresholding: digital CFAR*

Sweep Processing

The sweeps, which can have any desired length and thus no reduction in range resolution even at the largest range scales, undergo sweep integration, frequency merging and scan-to-scan correlation within the computer CPUs. This is where clutter and interference are greatly reduced, and where detections and echoes are generated.

- *Maximum PRF: any provided by the transceiver*
- *Range bins per sweep: any number*
- *Azimuth bins per scan: any number*

Plot Generation and Digital Video

Video echoes are collected into groups adjacent in azimuth and range. These plots may be used as target measurements for the tracking process. The video echoes are also used to generate digital video. Similarly to plot generation, groups of adjacent echoes are formed and representations of each group are generated. Different formats are available for presentation on the operator workstation, where the resulting radar picture approaches raw video quality. True raw video can also be generated around selected targets.

- *Digital video: fragments, polygons and true raw video*

Target Acquisition and Tracking

Each plot is checked against the tracked targets and if certain criteria are fulfilled the plot is associated with a tracked target. Any plots that are not associated with a tracked target may be used for acquisition of new tracks.

Tracking is performed using dual Kalman filter techniques as in the VET5070 in order to achieve stable vectors whether the vessel is manoeuvring or not. The Kalman filter is based on a dynamic mathematical model describing the vessel's movement, which is used to predict the vessel's behaviour between measurements. Each time a plot is assigned to the target, a position measurement is derived that is used to correct the state of the dynamic model.

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