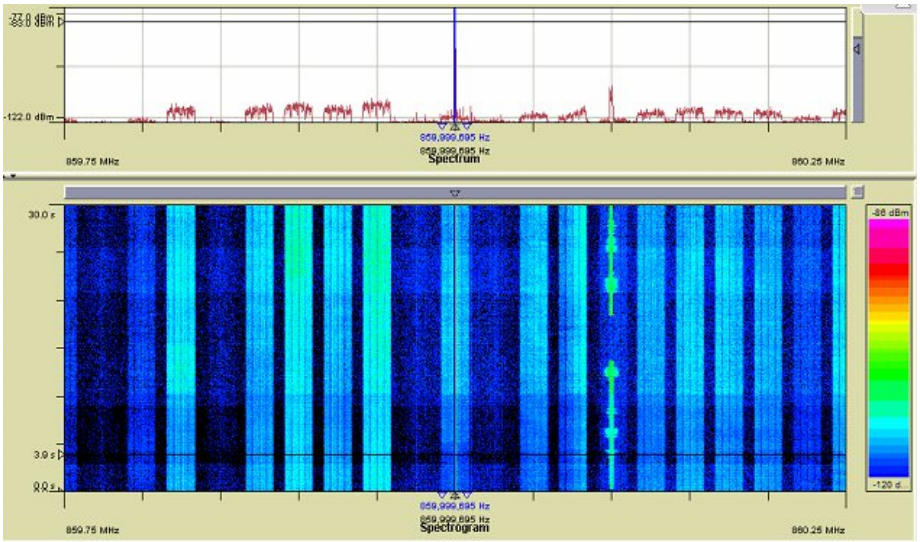
MEDAV

WIR VERSTEHEN DIE ZEICHEN DER ZEIT

KEEPING PACE WITH THE SIGNAL OF TIME

V/U/SHF Expertise

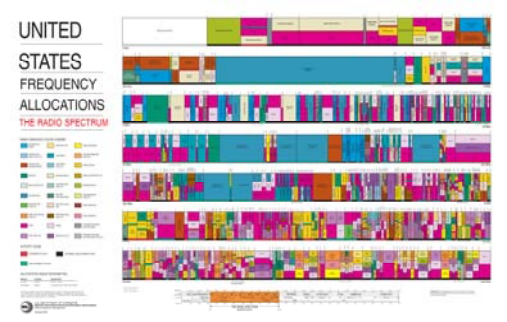


Products & Systems for V/U/SHF

An Overview

At a Glance

The V/UHF band, this is the radio frequency range between 30 and 3000 MHz, is occupied by many standardized and non-standardized radio communication systems. Many services in the field of radio broadcast, TV, police radio bands are allocated to these frequencies. Nowadays, SHF frequency band becomes more popular and is subject of measurements. Our products and solutions currently continue optionally the V/UHF band up to 6 GHz for both applications direction finding and monitoring.



Since frequency allocation is regulated nationally by local authorities or internationally e.g. by ITU, the International Telecommunication Union, the V/UHF bands are subject of spectrum monitoring. MEDAV provides measurement systems to authorities responsible to observe frequency bands. Typically monitoring of radio bands and detection of unauthorized radio emitters as well as their geo-localization are technical requirements for measurement systems needed.

V/UHF band is occupied by various radio services and communication systems which are of interest for governmental agencies and forces. MEDAV product portfolio covers the full application range:

- Reconnaissance by use of ARS-8000
- Surveillance by use of CRS-8000
- Technical signal analysis workplace by use of MIRA

Systems comprise, according to its application, antenna for intercept and direction finding, signal detection, emitter classification and identification, demodulation and decoding (production), reporting and alerting. MEDAV's technology is characterized by SDIA (Software Defined Intelligence Architecture) concept whereby the user of this technology takes benefit through its flexibility and scalability: Flexibility is caused by dedicated but flexible software payloads for the multi purpose processor "standard PC-network", and scalability is generated by configurable software modules, software design in client-server architecture, and scalable processor performance through configurable number of servers and clients.

MEDAV offers turn key system solutions as well as dedicated products and systems for work places or for integrators onto aerial, naval or land based vehicles or platforms.

Although cellular networks and other standardized communication systems like satellite communication occupy frequency bands within V/UHF, MEDAV is not developer of reconnaissance systems for these systems. MEDAV expertise is development and supplying of monitoring and reconnaissance systems for the non-standardized communication systems.

Portable radio communication devices are widely used in business, public safety, military, outdoor recreation, and the like. Rad io devices are available at numerous price points from inexpensive analogue units sold as toys up to ruggedized (i.e. waterproof or intrinsically safe) analogue and digital units for use on boats or in heavy industry.

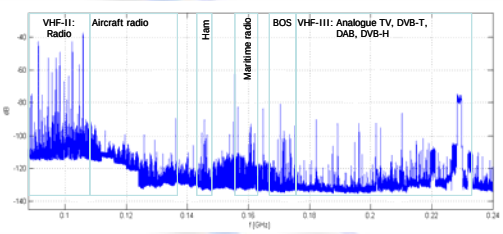
Here is a short and incomplete list of transmission and communication systems or users of related frequency bands as general information:

- Broadcast radio system (radio, TV; analogue and digital)
- Mobile communication (GSM, DECT, UMTS, …)
- Analogue Speech (BOS, Ham Radio, ISM, SRD, taxi, …)
- ISM, SRD (Remote Control, Microphone, …)
- Trunk Radio (Tetra, APCO16/25, Tetrapol, …)
- Pager (BOS, Pocsag…)
- Air and maritime radio (speech, navigation data, distance control, …)
- Satellite systems (GPS, Galileo, Thuraya, Inmarsat, Globalstar, DVB-S, …)
- Selcal-System
- Military communication systems (spread spectrum, radar signals, frequency hopper, …)

ARS-8000

Automatic Reconnaissance System

ARS 8000 is an automatic reconnaissance system providing functionality to increase efficiency and throughput in the detection, acquisition, processing and analysis of radio emissions. The system design is modular, scalable and flexible and allows configurations from 20 to more than 1000 processing channels.



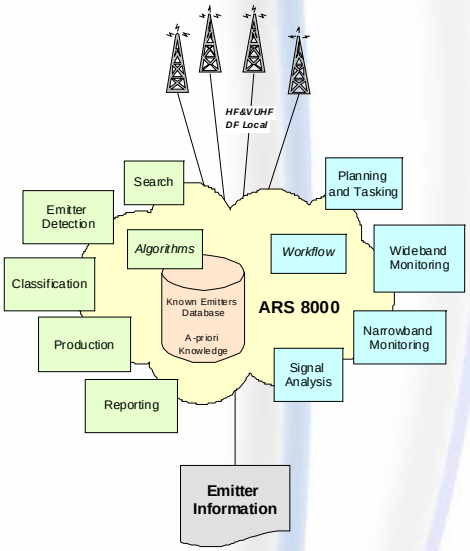
Building blocks of the ARS-8000 system are the Search Heads or Search & Production Units (SPU). Number and performance of the SPUs can be configured. SPU operation modes can be defined in individual missions and tasks.

Overview of the main features

- Modular, scalable and flexible system design
- Distributed configuration at several locations
- Automatic search & production
- No operator needed for the production
- Analogue and digital transmission methods
- Automatic processing of routine tasks
- Low level reports about detected emitters
- DF Support

Processing Chain

- Search – the system receives a wideband signal, either by scanning or by using a tuner with large bandwidth.
- Detection – the system detects emitters in the wideband signal.
- Classification – the system classifies the emitters and searches for a-priori knowledge about them or similar emitters in the internal database.
- Production – the system produces an emitter if it finds a-priori knowledge about it, or tries production with parameters of similar emitters. If production fails, the system may take a sample record for later manual analysis.
- Report – all activities and results are logged and summarized in emitter specific reports stored on a central server.



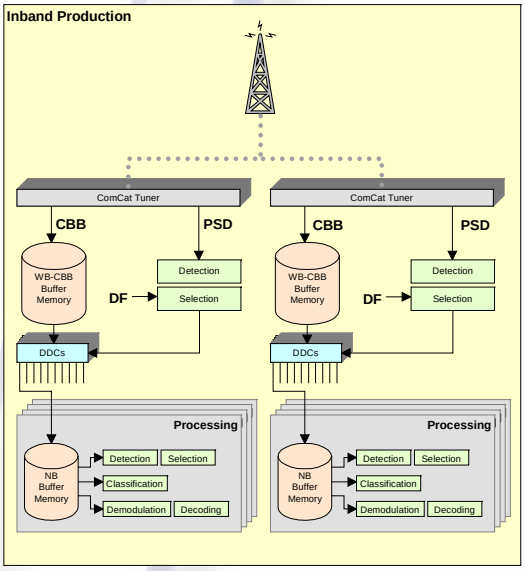
The steps are embedded in a system specific workflow beginning with setting up, scheduling and planning missions and tasks, followed by monitoring spectra and emitters, and ending in analysis and post processing.

ARS-8000 can be processed in different operation modes.

- Inband Production
  The system works in a wideband signal, without scanning.
- Outband Production
  Search and detection are conducted in the scanned wideband range, classification and production is performed by hand-off receivers.
- Integrated & Combined Search
  Search, detection and classification are realized in the scanned wideband range. Production is performed by hand-off receivers.

Inband Production ARS-8000

When inband production is used, the wideband frequency range is covered by a number of tuners each working at fix frequency acquiring the wideband complex base band (CBB) signal as well as power spectra density (PSD); CBB and PSD are calculated by the wideband CCT tuner. The CBB is stored in a circular memory so that the signal history is accessible and thus the signal contents are available from the beginning, even before it was detected.



Tuner data are evaluated to detect the emitters. Signals of the emitters detected are extracted from the CBB by software digital down converters (DDC), narrowband signals are obtained. The narrowband signals extracted are subject of further processing, e.g. classification, demodulation, decoding etc.

The figure left illustrates as an example inband production at which the frequency range to observe is covered by 2 tuners. The number of DDCs and subordinate processing units is configurable in the system design:

Specialized acquisition and processing software operates all channels at a time, without signal loss, including all channel switching and DF capabilities. It is just dedicated software (and suitable PC processor performance) which is needed to use the wideband resources efficiently.

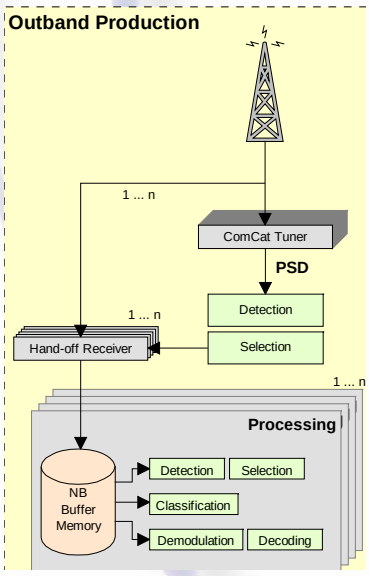
SPU bandwidth can be defined from 2 MHz up to 24 MHz and is affected on the existing target channel grid.

Application scenario: In dense signal scenario like short-range device, citizen-band, low-power communication device, etc.

Outband Production ARS-8000

When outband production is used, a CCT tuner acts as a search tuner and scans the desired wideband frequency range step-by-step over time. For this reason, no wideband CBB recording is performed or possible, signal history is not available so that a signal cannot be produced before it is detected.

The scanned PSD information is used for detection of emitters. Emitter information is passed to hand-off receivers that capture a narrowband CBB signals (< 200 kHz) to further processing, e.g. classification, demodulation, decoding etc. V/UHF LAN-Receiver are used as hand-off receiver, other existing V/UHF receiver can be connected to the system.



To set up a mission, the following information is required:

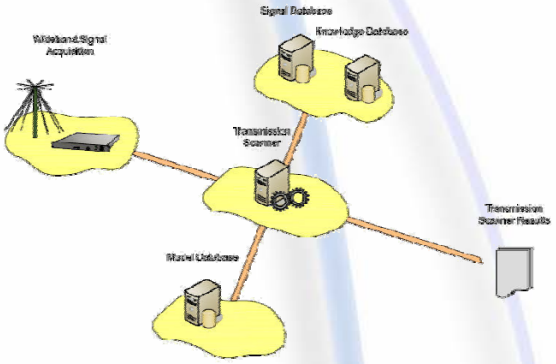
- Frequency ranges within the search head is instructed to scan
- Antenna if there is a choice of several antennas connected to the search head
- Block list to exclude disturbing or obsolete emitters for any kind of processing
- Priority list to emphasize defined frequency channels to be processed.
- Parameters for controlling of the detection of emissions
- Search receiver: Frequency bandwidth and dwell time for the search has to be configured depending on mission and task.
- Number and type of hand-off receivers have to be defined depending on the operation mode.

Application scenario: In distributed signal scenario or for signal scenario determination

Integrated & Combined Search in ARS-8000

When integrated & combined search applies, a CCT tuner operates as a search tuner and scans the desired wideband frequency range step-by-step over time. Search is an integrated solution for detection, segmentation, classification and identification of known and unknown emissions. This functionality is performed by the Transmission Scanner.

For production purposes, hand-off receivers and inband production wideband receivers can be used to realize an optimum of flexibility to face the operational needs.



The approach is characterized by:

- Integration of detection and classification
- Use of application dependent a-priori knowledge
- Possibility to add new transmission standards
- Definition of a knowledge database with geographical dependencies

The Transmission Scanner uses several internal databases which can be completed and supported by the customer:

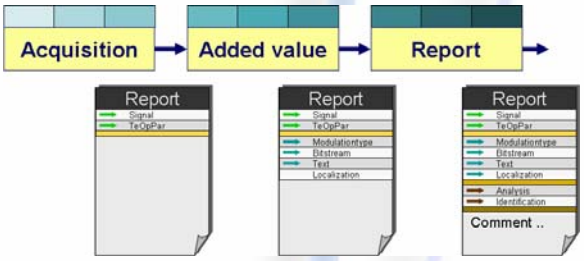
- Model database, which contains transmission classes, sampling rates, applications and used receiver types
- Signal database, which contains recordings with xml-labels of V/UHF scenarios
- Knowledge database, which contains technical description of transmission standards, includes storage of a-priori knowledge like location dependent frequency lists and workflow instructions.

Application scenario: In dense and distributed signal scenario (fixed frequency and scanning mode)

Automation of routine work

Subject of reconnaissance is to monitor the electromagnetic scenario to gather information with is helpful for identification of criminals, networks of criminals, threats etc. For that reason, radio emitters have to be captured and analyzed against dedicated intelligence requirements. The practical work behind this requirement is a big challenge and addresses problems of radio emitter capturing, detection, geo-localization, classification and identification, demodulation and decoding (production), and assessment and evaluation of the content – 24/7 in time.

Since on the one hand side, the number of radio emitters which are subject of interest is huge, and on the other hand, the number of human operators for performing the full intelligence task is small and the correlated costs expensive, economical approaches to the problem are needed. Automation of routine work is the key.



ARS-8000 provides all the necessary capabilities and tools, which yield the benefit of unloading the operators from routine work. ARS-8000 achieves a significant share of fully automated generated results. Operators concentrate on supervising the system, control, and investigations on these emissions when automated processing can not apply or has failed.

ARS-8000 is available for HF and V/UHF applications.

Please refer to the chapter SiPaC when automated content processing and analysis is required, e.g. for automated speech and text processing.

CRS-8000

Compact Reconnaissance System for Spectrum Monitoring Tasks and Applications

CRS-8000 is MEDAV's product family for compact systems in H/V/UHF to support the following tasks:

- Monitoring of radio scenarios comprising acquisition, direction finding and localization of radio emitters.
- Surveillance of radio scenarios comprising acquisition, recording, direction finding, classification, identification of radio emitters, as well as tracking and warning capabilities, and reporting.
- Reconnaissance of radio scenarios including acquisition, recording, direction finding, classification, identification and production of radio emitters and reporting.

Flexible payload in software and wide configuration capabilities in hardware meet customer requirements for the CRS-8000. High degree of automation is standard for tasks performance, and manual operation is supported.

Hardware configuration capabilities are available for

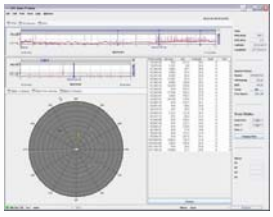
- Wideband direction finding (DF) tuners
- Wideband hand-off receivers
- Server
- Recording
- Work places (multi functional operating console - MFC, PC or notebook)
- Rigs
- Compliance to dedicated environmental demands on request

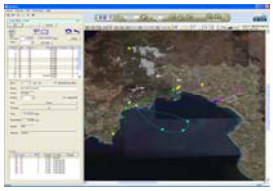
Antenna system comprises:

- DF antennas for V/UHF and H/V/UHF
- Intercept antennas HF and V/UHF
- Limiters
- Automated self-calibration
- Compliance to dedicated environmental demands on request

Software configuration determines system capabilities:

- Searching
- Monitoring
- Direction finding
- Automated classification
- Automated identification
- Automated reporting
- Tracking
- Analysis
- Interception
- Demodulation & decoding
- Production
- Wideband recording
- Narrowband recording
- Listen-in
- Frequency hopper processing
- Warning
- Map representation (EOB – Electronic order of Battle)
- Interface to intelligence fusion system
- HMI software to control the system and display results





Solutions for surface vessels and submarines

Particular solutions are available for surface vessels and submarine. Reconnaissance and surveillance, early warning and collection of information of the surrounding communication signals are capabilities supported.

The systems detect, intercept, measure, characterise and identify signals in the desired frequency range, while offering very good bearing accuracy over the full azimuth and a wide elevation with the intended antenna. Good results strongly depend on proper condition of the RF-chain therefore, it can be calibrated on-board.

Successful operation, accurate DF results and flexible payload through software oriented architecture are some benefits which characterize CRS-8000.

Operational Modes
Depending on the mission, the system can be used in different modes of operation:

- **Search**
  Search for signals of interest, bearing, detection and identification of emitters
- **Analysis**:
  Signal analysis to get detailed technical parameters of detected emitters
- **Monitoring**:
  Surveillance of radio traffic, production of message content
- **Reporting**:
  Condensing the results and reporting for decision

Solutions for shelters and land vehicles

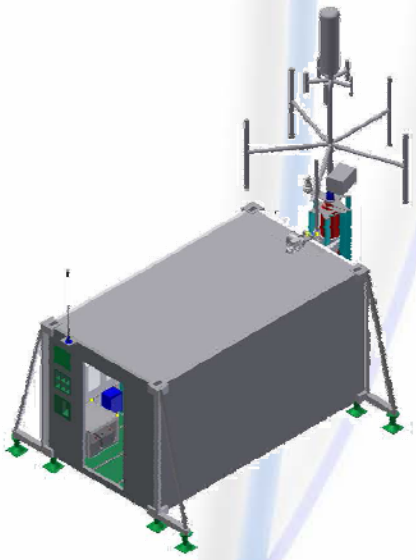
Solutions for national regulation and network authorities are available e.g. for shelters. Main objective of this configuration of a CRS-8000 system is the accurate direction finding (DF) of radio emitters. Typically V/UHF and SHF are frequency bands of interest.

The DF equipment is integrated inside the shelter but the DF antenna is placed outside at a hoistable mast system. The shelter is equipped with all instruments and devices which are necessary for remote operation, e.g. air condition, weather station, mast system with status information, power supply and security equipment (IR camera, CCTV, fire alarm system, intrusion detection system).

System can be used fully remote controlled or autarkic.

Operation Modes
System can be operated in following operational modes:

- **General Operation Mode**
  Measurement equipment is ready to run (remote or manual controlled).
- **Intercept mode**
  Intercept measurement equipment is running in trigger mode. After exceeding of the energy threshold the system will be activated automatically.
- **DF mode**
  The DF system is active and the intercept receiver is in standby. The DF system can be remote controlled or autarkic by using several trigger modes for automated data recording.
- **Standby mode**
  Measurement equipment is switched off, only remote control communication is active; all PCs are in stand-by mode.
- **Failure Mode**
  This mode will be activated by a failure (power supply, defect devices, etc.). Only communication system is running for status request.



MIRA

Intercept – Interactive Technical Signal Analysis

MIRA is a scalable signal analyzer for HF, and V/UHF. CCT tuners (and other standard modules) allow wideband monitoring and recording: MIRA enables (tuner option dependent) the online and offline monitoring of up to 24 MHz wide band in a freely selectable frequency range between 100 kHz and 3 GHz as well as the recording of up to 16 MHz band in the monitoring range. MIRA offers server-supported wideband recording and data storage. The stored data are analysed by different offline functions. MIRA is implemented as a client-server system, so that the number of workstations is flexible and it is simple to add additional analysis stations later. Special features of MIRA are:

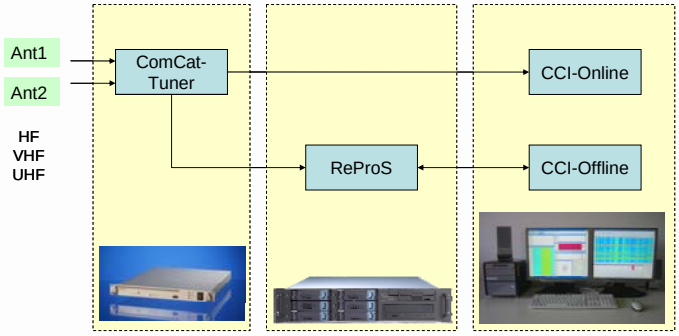
- Online wideband monitoring of up to 24 MHz for HF and V/UHF with a display of the spectrum and spectrogram (panorama display)
- Fixed setting of the 24 MHz band and scan operation over the complete HF and V/UHF range
- Energy triggered or manual triggered wideband recording of up to a 16-MHz band in the HF and V/UHF-range on the hard disk server, whereby the recording band lies within the monitoring band
- Production of up to 2 narrowband signals
- Energy triggered or manual triggered narrowband recording of complex and demodulated data
- CCT tuner for two antennas (1 x HF, 1 x V/UHF) with internal channel switch-over and raw data processing
- Innovative client-server architecture for network-oriented analysis workstations
- Offline-analysis of wideband signal
- Automatic and interactive demodulation & decoding
- Use of standard modules for acquisition (CCI-Online), recording (ReProS) and offline analysis (CCI-Offline)
- Simple system extension for analysis through plug-ins, e.g. OC-6040 signal analysis software
- Robust device design of the acquisition equipment: standard PCs, standard network components

MIRA is successfully established in the market.

Modular Configuration from Standard Components

The CCT (ComCat) tuner acquires the antenna signals. Thereby, depending upon the parameter settings of the tuner, internal antenna switching is done automatically, in order to monitor the frequency range set in the HF and V/UHF band. The tuner calculates the short-time spectrum for a freely selectable up to 24-MHz interval for online display and analysis in CCI-Online. The CCT tuner delivers the complex basic wideband signal of up to a 16 MHz wide signal on a second output channel to record the data on the ReProS server, which calculates the navigation data.

CCI-Offline uses the navigation data to select signal segments and enables comprehensive analyses. CCI-Online and CCI-Offline are clients and need one PC each for simultaneous operation



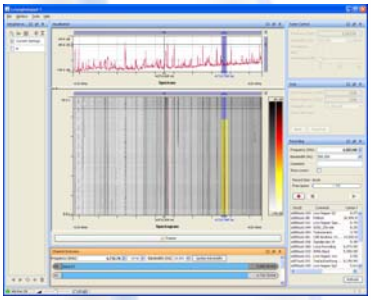
Workstations

An exemplary workstation configuration for stationary application comprises a PC, two TFT-displays and speakers.

For mobile applications, e.g. for operation in vehicles, use of ruggedized notebooks or shuttle PCs for online and offline analysis are recommended

Online Acquisition, Recording & Analysis in MIRA with CCI-Online

CCI-Online is a software solution in the MEDAV's proprietary ComCat system concept, implemented by using "Virtual Devices". CCI-Online supports wideband and narrowband signal acquisition and the visualisation of short-time spectra and spectrograms (panorama-displays). CCI-Online is the operating panel for the CCT tuner and setting of recording parameters. The narrowband analysis for analogue signals including demodulation, software-driven message extraction as well as the audio output of the demodulated signal are essential processing options of CCI-Online. The performance scope of CCI-Online can be extended extensively through additional virtual devices and plug-ins



Offline Analysis in MIRA uses CCI-Offline

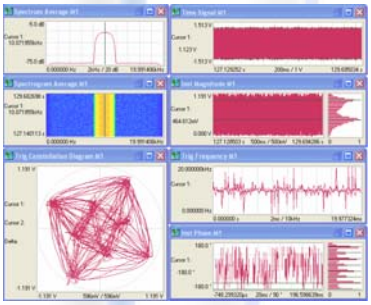
CCI-Offline is a software solution in the MEDAV's proprietary ComCat system concept. CCI-Offline supports the user in navigation in the recorded wideband data, signal segmentation and analysis.

Offline Analysis, Classification, Demodulation

MIRA contains numerous methods for offline analysis of wideband and narrowband signals with OC-6040. Various options extend analysis functions by plug-ins. MIRA supports fast access to the stored signals, browsing in these data, segmenting as well as interactive or automatic analysis, classifier, demodulator and decoder functionality.

CCT-Tuner

The CCT tuner is suitable to be used for HF and V/UHF. It is characterized by a gap-less real-time capability, large signal dynamics and internal signal processing possibilities



Recording Server ReProS

The recording server ReProS is a standard module of the ComCat system. ReProS records the IF wideband signals and calculates and stores navigation data. A desired signal section in the wideband signal can be located quickly via CCI-Offline and be marked for analysis. ReProS requires the use of the CCT tuner (other tuners upon request).

Antennas: Sample Configuration

Technically, MIRA does not require specific antenna, just interface requirements for the CCT tuner need to be considered. Two antenna inputs are available at the CCT tuner. An internal switch in the tuner supports the automatic signal acquisition over the frequency range of the individual antennas.

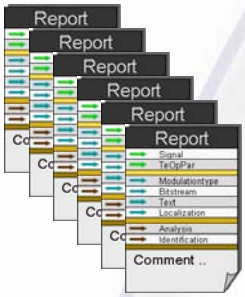
SiPaC

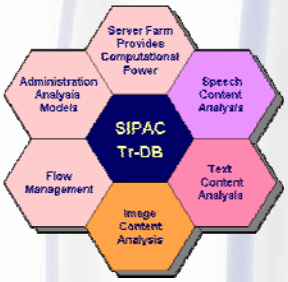
Mass data processing

SIPAC is a framework to process mass data in a well defined, configurable workflow. It offers solutions for handling of different types of data and quality assurance for processing systems. The framework provides a high degree of flexibility in many regards (size, types of information to process, workflow) and is widely open for scalability.

Typical applications are:

- Analysis of speech data, e.g. recognition of speech, identification of language, speaker, topic, keywords
- Analysis of text, e.g. identification of language, topic
- Automated translation and abstract generation
- Image file analysis, e.g. spam filter, steganography, picture analysis
- Demodulation & decoding of modulated signals
- Miscellaneous, e.g. automated unzip, file type recognition





- Additional metadata
- Additional content
- Translations
- Others

SiPaC is characterized by the following features:

- Framework for mass data processing and classification
- File oriented processing (Input: files, output: files with meta data)
- User configurable signal flows for processing chain
- Server client concept (different configurations possible)
- Scalable in processing power and flexible by use of standard IT hardware/software
- User interface for operator
- Archive for storage of: signals, configurations, flows, other data
- Different configurations available
- Configuration for speech classifiers:
    - Trainable classifiers for usage for mass data processing
    - Training environment for speech classifiers (MELANIE)
    - Archive for corpora for classifiers
- Configuration for customer specific tools:
    - Open interface for customer's programs

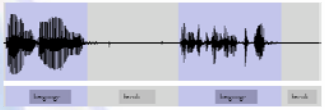
ARS-8000 - SiPaC

ARS-8000, the automated reconnaissance system generates reports which are separate files and can comprise metadata, original data and content.

SiPAC is the framework which provides flow management of data, especially file oriented data, processes these data automatically according to the analysis configuration (speech, text …). Analysis results are additional metadata, e.g. achieved by application of MELANIE speech classifiers, third party products or customer's own developed software.

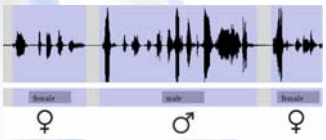
MELANIE

…for speech analysis



MELANIE describes our family of software modules, which realizes an automatic analysis of speech signals. The objective of analysis can vary, e.g. the determination of used language, speaker, topic; or hierarchical classification may become necessary, like speaker identification only for Turkish language. The support that MELANIE offers is to find out those signals from a large number of speech signals, which fulfil one or several characteristics, e.g. concerning a special language or a known speaker.

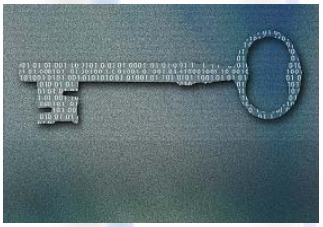
The individual module is trained with respect to the language scenario and speaker groups. For this suitable data is required, which must be carefully selected, prepared and sufficient in number.



Essential characteristics of MELANIE are:

- Classification of languages, speakers, gender, topics (Topic Spotting) and key words (Word Spotting)
- Additional module for language signal enhancement, speech detection, data format conversion
- Training environment
- File or stream oriented processing (Online/Offline)
- Decision per file or decision per time segment

Image processing modules from MEDAV



MEDAV offers the following modules for image analysis.

- **OCR (optical Character recognition):**
  Extracts textual content from images
- **HiTex:**
  Analyses raster graphics images from exbedded text information
- **Steganographics:**
  Analyses raster graphic (bitmap) images for hidden information embedded by means of steganography, that is: hidden secret information embedded in other data.
- **ImageChecker:**
  Searches image files of different formats for peculiarities as attachments, insertions, filled areas, pads, etc.

Third party products for text analysis

MEDAV offers third party products for text analysis:

- **Language Identification:**
  Identifies the language in which a text is written. The tool is familiar with a set of languages, from which it either selects the recognised language, or it rejects the file.
- **Key Term Extraction:**
  Identifies single word key terms in a text, either by extracting the terms from the text, or by applying a filter bank of relevant terms to be searched for.
- **Entity Recognition:**
  This tool identifies names (entities) in texts. Names can be of different type: persons, places, companies, institutions, dates, currencies.
- **Term Substitution:**
  Translates terms in texts from a source language to a target language.
- **Translation:**
  This tool translates texts from a source languages to a target language

Corporate Policy

Technology

… in the products, development and in the company management is state-of-the-art and represents a top level.

Quality

... in all divisions of our company is considered as the indispensable prerequisite for a risk-free and successful cooperation with our customers and business partners.

Position in the market

… is affected by extensive experience gained from signal and information processing. We are prepared best to face competition.

Product and engineering spectrum

… are comprehensive, complete and tailored to meet all requirements. As a single source supplier of solutions, we offer standard devices, systems and services.

Employees

… form the roots of the company and render the services necessary for maintaining and expanding the technical basis and a trustful and fair cooperation.

Growth

... on a stable technical and economical basis at home and abroad is our declared long-term goal.

Trust and fairness

… vis-à-vis our business partners and within the company are the basis of our business.

Compliance

... with excessive sensibility and compliance with German and international export regulations we act on a worldwide basis.

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