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(54) ELECTRONIC WARFARE SYSTEM WITH DATA LINK COMMUNICATIONS CAPABILITIES

(57) Disclosed herein is an electronic warfare system (1,2), configured to operate in an electronic warfare mode and comprising processing means (14), that are configured to: receive an incoming analog signal; convert the incoming analog signal into an incoming digital signal; and, when the electronic warfare system (1,2) operates in said electronic warfare mode, perform a predefined electronic support measure or countermeasure function on the basis of the incoming digital signal. The electronic warfare system (1,2) is characterized by being further configured to operate in a data link communications mode, wherein the processing means (14) are further configured, when the electronic warfare system (1,2) operates in said data link communications mode, to perform a data link communications function by carrying out: a predefined digital demodulation on the basis of the incoming digital signal so as to extract information symbols carried by said incoming digital signal; and a predefined digital modulation by producing a communication digital signal carrying information symbols to be transmitted.

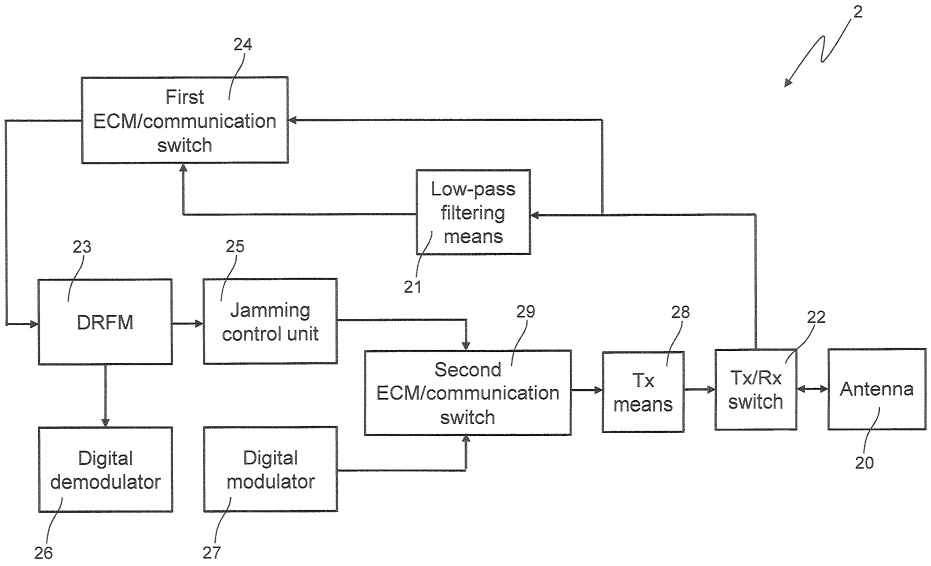

Fig. 2

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Description

TECHNICAL FIELD OF THE INVENTION

[0001] The present invention relates to an electronic warfare (EW) system, such as an electronic support measure (ESM) and/or electronic countermeasure (ECM) system, that is designed to perform, in addition to one or more predefined ESM and/or ECM functions, also a data link communications function. In other words, the present invention concerns an EW system with data link communications capabilities in addition to its intrinsic ESM and/or ECM ones.

BACKGROUND ART

[0002] As is broadly known, the terminology "electronic warfare" (EW) is used to denote any military action/procedure/operation/system/apparatus involving the use of the electromagnetic spectrum (not limited to radio frequencies (RFs), but including infrared, visible, ultraviolet, and also other spectrum portions) in order to attack an enemy, detect a threat, or defend from an enemy attack.

[0003] Generally, EW includes three major subdivisions:

- electronic attack (EA), or electronic countermeasures (ECMs), involving the use of systems, devices and/or techniques that exploit the electromagnetic spectrum to degrade, neutralize or destroy enemy combat/defensive capabilities;
- electronic protection (EP), or electronic counter-countermeasures (ECCMs), involving the use of systems, devices and/or techniques to defend from enemy EAs or, more in general, from enemy use of the electromagnetic spectrum; and
- electronic support (ES), or electronic support measures (ESMs), involving the use of systems, devices and/or techniques to search for, detect, intercept, identify, locate and analyze sources of radiated electromagnetic energy for the purpose of threat recognition, targeting, planning and conduct of future operations.

[0004] Examples of ECM systems are the so-called radar ECM (R-ECM) systems using digital radio frequency memories (DRFMs) for radar jamming and deception.

[0005] In particular, as is known, a DRFM is generally configured to:

- convert an incoming signal (at (high) RF or intermediate frequency (IF)) into digital format by means of one or more analog-to-digital converters (ADCs);
- store on a memory the digital samples thus obtained;
- digitally process said stored digital samples (for example, by performing a frequency and/or phase offset, and/or a frequency, phase and/or amplitude modulation, etc.); and
- convert the digital signal thus obtained into analog format by means of one or more digital-to-analog converters (DACs), thereby obtaining an output signal to be retransmitted (for example in order to create false radar targets, Doppler errors in a victim receiver, distorted phase-fronts at a victim receiver antenna, etc.).

[0006] An example of DRFM is disclosed in US 8,659,453 B1, that relates to a DRFM utilizing time-interleaved ADCs and time-interleaved DACs.

[0007] Instead, ESM systems are used, as previously said, to search for, detect, intercept, identify, locate and analyze sources of radiated electromagnetic energy, often for the main purpose of detecting threats, such as the so-called radar ESM (R-ESM) systems designed to warn that a fire control radar has locked on a combat vehicle, ship, or aircraft.

[0008] Generally, ESM systems employ ultra-wide band (UWB) receivers designed to cover microwave bands from 0.5 GHz up to 20 GHz, or even 40 GHz.

[0009] Nowadays, many ESM systems employ receivers which are configured to:

- shift incoming RF signals to lower frequencies (such predetermined IFs) by means of mixers operatively coupled to local oscillators;
- convert the frequency-downshifted signals thus obtained into digital format by means of analog-to-digital (A/D) conversion means; and
- process the digital signals thus obtained by means of digital processing means, conveniently programmable devices such as Digital Signal Processors (DSPs) and/or Field-Programmable Gate Arrays (FPGAs), which are configured to perform one or more predefined ESM functions, in particular by carrying out several operations which can conveniently include (but are not limited to) fast Fourier transforms (FFTs).

[0010] An example of ESM system of the above type is disclosed in US 7,482,967 B2, that relates to an apparatus for characterizing an input signal within a broad frequency band by comparing the same input signal in a plurality of channels, in order to operate digital ESMs which require a broad bandwidth to function.

[0011] Instead, a completely different reception architecture for EW systems, in particular for ESM systems, is disclosed in Applicant's International application WO 2015/132772 A2, that relates to a photonic-assisted RF spectrum scanner for UWB receivers.

[0012] Current EW systems of the ESM type and ECM type are exclusively designed for and dedicated to ESM and ECM functions, respectively.

[0013] Instead, as is known, communications between military systems, platforms, vehicles, aircrafts, naval units, etc. are currently implemented by means of specific communication apparatuses, that are exclusively and

specifically designed for and dedicated to this end. In particular, military communication apparatuses are configured to provide communication functions (via radio or cable) which are based on specific military standards and protocols.

[0014] For example, NATO armed forces use the so-called Tactical Data Links (TDLs), formerly Tactical Digital Information Links (TADILs), that are characterized by their own message and transmission formats. For instance, NATO TDL standards include:

- the so-called "Link 11", that is a secure half-duplex radio link used to exchange digital data, such as radar tracking information, among airborne, land-based and ship-board tactical data systems;
- the so-called "Link 22" designed to replace Link 11; and
- the so-called "Link 16" used to exchange, among military aircrafts, naval units and ground forces, their tactical picture in near real-time; moreover, Link 16 also supports voice communications and exchange of text messages and imagery data.

[0015] The TDLs were conceived so as to enable communications among a huge number of military systems, platforms, vehicles, aircrafts, naval units, etc. deployed over a wide area. On the other hand, the TDLs are characterized by data rates that are relatively low in comparison with modern communication systems.

[0016] Moreover, some TDLs, such as Links 11 and 22, involve exclusively the transmission of messages selected from a predefined list and this results in an efficient use of the band, but also in a severe limitation on flexibility.

[0017] Finally, the level of cooperation and coordination of the interconnected military communication apparatuses that is achievable by the TDLs is lower in comparison with modern networked communication systems, thereby resulting in that the TDLs are not very suitable for achieving enhanced efficacy according to the so-called "network operating capability" (NOC) and "network-enabled capability" (NEC) philosophies.

OBJECT AND SUMMARY OF THE INVENTION

[0018] A general object of the present invention is that of overcoming, at least in part, the above drawbacks of the current military communication systems, such as TDLs.

[0019] In particular, a specific object of the present invention is that of providing a system for military communications which is characterized by data rates, flexibility, and efficacy of cooperation and coordination that are higher than those of the current military communication systems, such as TDLs.

[0020] These and other objects are achieved by the present invention in that it relates to an electronic warfare system with data link communications capabilities, as defined in the appended claims.

[0021] In particular, the present invention relates to an electronic warfare system that is configured to operate in an electronic warfare mode and that comprises processing means configured to:

- receive an incoming analog signal;
- convert the incoming analog signal into an incoming digital signal; and,
- when the electronic warfare system operates in said electronic warfare mode, perform a predefined electronic support measure or countermeasure function on the basis of the incoming digital signal.

[0022] Said electronic warfare system is characterized by being further configured to operate in a data link communications mode, wherein the processing means are further configured, when the electronic warfare system operates in said data link communications mode, to perform a data link communications function by carrying out:

- a predefined digital demodulation on the basis of the incoming digital signal so as to extract information symbols carried by said incoming digital signal; and
- a predefined digital modulation by producing a communication digital signal carrying information symbols to be transmitted.

BRIEF DESCRIPTION OF THE DRAWINGS

[0023] For a better understanding of the present invention, preferred embodiments, which are intended purely by way of example and are not to be construed as limiting, will now be described with reference to the attached drawings (not to scale), where:

- Figure 1 schematically illustrates an EW system with data link communications capabilities according to a general preferred embodiment of the present invention; and
- Figure 2 schematically illustrates a DRFM-based ECM system according to a specific preferred embodiment of the present invention.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS OF THE INVENTION

[0024] The following discussion is presented to enable a person skilled in the art to make and use the invention. Various modifications to the embodiments will be readily apparent to those skilled in the art, without departing from the scope of the present invention as claimed. Thence, the present invention is not intended to be limited to the embodiments shown and described, but is to be accorded the widest scope consistent with the principles and features disclosed herein and defined in the appended claims.

[0025] The present invention stems from Applicant's

innovative idea of reusing, for communication purposes, military apparatuses currently dedicated to other tasks, in particular EW systems currently dedicated only to ESM and/or ECM functions.

[0026] In fact, the Applicant has noticed that design and development from scratch of a new military data link including allocation of new hardware, such as transceiver, RF front-end, antenna, etc., is not acceptable due to highly severe requirements, in terms of weight and space, that apply to equipment to be installed on board military platforms, vehicles, aircrafts, naval units, etc., that are already overcrowded.

[0027] Therefore, since military electronic system design is currently moving towards a more and more extensive use of embedded programmable processing devices, such as DSPs and/or FPGAs, the Applicant has cleverly realized that the so-called "Software Defined Radio" (SDR) paradigm could be advantageously exploited in order to reuse, for communication purposes, hardware means (such as embedded programmable processing devices, antennas, etc.) already installed, for other purposes, on board military platforms, vehicles, aircrafts, naval units, etc..

[0028] In fact, according to SDR paradigm many functions traditionally implemented by dedicated hardware can now be implemented by embedded programmable processing devices, such as DSPs and/or FPGAs, thanks to continuous increase in computing capabilities of these devices and to the capability of said devices to be configured and reconfigured to perform different tasks by loading different software and/or firmware programs thereon.

[0029] Thence, the present invention relates to an EW system, that is configured to operate in an EW mode and that comprises processing means configured to:

- receive an incoming analog signal;
- convert the incoming analog signal into an incoming digital signal; and,
- when the EW system operates in said EW mode, perform one or more predefined ESM or ECM functions on the basis of the incoming digital signal.

[0030] Moreover, the EW system according to the present invention is further configured to operate also in a data link communications mode. In particular, the processing means are further configured, when the EW system operates in said data link communications mode, to perform a data link communications function by carrying out:

- a predefined digital demodulation on the basis of the incoming digital signal so as to extract information symbols carried by said incoming digital signal; and
- a predefined digital modulation by producing a communication digital signal carrying information symbols to be transmitted.

[0031] Preferably, the EW system further comprises an antenna, preferably an active phased array antenna, that is configured to receive and transmit radio frequency signals having frequencies comprised in a predefined microwave band; wherein the incoming analog signal in indicative of a radio frequency signal received by the antenna; and wherein the antenna is operable to transmit a radio frequency signal indicative of the communication digital signal.

[0032] Conveniently, the processing means are further configured to:

- carry out a fast Fourier transform of the incoming digital signal thereby producing digital frequency samples; and,
- when the EW system operates in said data link communications mode, carry out the predefined digital demodulation on the basis of the digital frequency samples so as to extract information symbols carried by said digital frequency samples.

[0033] Alternatively, the processing means are conveniently configured, when the EW system operates in said data link communications mode, to carry out the predefined digital demodulation on the basis of digital time samples of the incoming digital signal so as to extract information symbols carried by said digital time samples.

[0034] For a better understanding of the present invention, Figure 1 shows a block diagram schematically representing an architecture of an EW system (denoted as a whole by 1) with data link communications capabilities according to a general preferred embodiment of the present invention.

[0035] In particular, the EW system 1 is configured to operate in an EW mode and also in a data link communications mode, and includes:

- an antenna 11, preferably an active phased array antenna, that is configured to receive and transmit RF signals having frequencies comprised in a predefined microwave band, such as from 0.5 GHz up to 20 GHz, or even 40 GHz;
- pre-processing means 12, that are connected, through a transmit/receive (Tx/Rx) switch 13, to the antenna 11 to receive the RF signals received by said antenna 11, and that are configured to carry out a pre-processing of said received RF signals thereby producing corresponding pre-processed signals, wherein said pre-processing conveniently includes (but is not limited to) one or more of the following operations:
  - amplification, such as low-noise amplification;
  - filtering, such as low-pass and/or anti-aliasing filtering; and
  - frequency downshift, such as frequency downshift to one or more predefined IFs and/or to baseband (BB); and

- processing means 14, that are connected to the pre-processing means 12 to receive the pre-processed signals therefrom, and that include

  - A/D conversion means 15 configured to convert the (analog) pre-processed signals into corresponding digital signals, and
  - digital processing means 16, conveniently programmable processing means such as one or more DSPs and/or FPGAs, that are configured to perform, on the basis of the digital signals supplied by the A/D conversion means 15, one or more predefined ESM and/or ECM functions or a data link communications function depending on whether the EW system 1 is operating in said EW or data link communications mode.

[0036] In detail, when the EW system 1 operates in the EW mode, the digital processing means 16 perform the predefined ESM and/or ECM function(s) on the basis of the digital signals currently supplied by the A/D conversion means 15 (i.e., the digital signals supplied by said A/D conversion means 15 when the EW system 1 is operating in said EW mode).

[0037] Conveniently, the digital processing means 16 are configured to perform a specific predefined ECM function by producing, on the basis of a digital signal supplied by the A/D conversion means 15, a corresponding ECM digital signal to be transmitted (such as in the case of operation as DRFM, in which the produced ECM digital signal to be transmitted is related to the digital signal currently supplied by the A/D conversion means 15).

[0038] Instead, when the EW system 1 operates in the data link communications mode, the digital processing means 16 perform the data link communications function by carrying out:

- a predefined digital demodulation on the basis of the digital signals currently supplied by the A/D conversion means 15 (i.e., the digital signals supplied by said A/D conversion means 15 when the EW system 1 is operating in said data link communications mode), so as to extract information symbols carried by said digital signals; and
- a predefined digital modulation by producing communication digital signals carrying information symbols to be transmitted.

[0039] Said predefined digital modulation and demodulation can be any type of digital modulation/demodulation. In particular, said predefined digital modulation and demodulation can be conveniently based on one of the following digital modulation/demodulation techniques: amplitude-shift keying (ASK), amplitude and phase-shift keying or asymmetric phase-shift keying (APSK), continuous phase modulation (CPM), frequency-shift keying (FSK), multiple frequency-shift keying (MFSK), minimum-shift keying (MSK), phase-shift keying (PSK), quadrature amplitude modulation (QAM), single-carrier frequency-division multiple access (SC-FDMA), orthogonal frequency-division multiplexing (OFDM), code division multiple access (CDMA) modulation, or a spread spectrum modulation.

[0040] Preferably, the digital processing means 16 are configured to:

- carry out a FFT of the digital signals supplied by the A/D conversion means 15, thereby producing corresponding frequency-domain digital signals; and
- perform,

  - when the EW system 1 operates in the EW mode, at least one predefined ESM or ECM function on the basis of the frequency-domain digital signals (i.e., on the basis of the digital frequency samples of the digital signals supplied by the A/D conversion means 15, which digital frequency samples are obtained via FFT), and,
  - when the EW system 1 operates in the data link communications mode, the predefined digital demodulation on the basis of the frequency-domain digital signals (i.e., on the basis of the digital frequency samples of the digital signals supplied by the A/D conversion means 15, which digital frequency samples are obtained via FFT).

[0041] Alternatively, the digital processing means 16 are conveniently configured to apply the predefined digital demodulation directly to the digital time samples supplied by the A/D conversion means 15.

[0042] Moreover, the processing means 14 further include digital-to-analog (D/A) conversion means 17 configured to convert the ECM digital signals and the communication digital signals produced by the digital processing means 16 (in said ESM/ECM and data link communications modes, respectively) into corresponding analog signals to be transmitted.

[0043] Finally, the EW system 1 further includes transmission (Tx) means 18, that are:

- connected to the processing means 14 to receive therefrom the analog signals to be transmitted;
- configured to transform said analog signals to be transmitted into corresponding RF signals to be transmitted (conveniently by performing a frequency upshift to RFs comprised in the aforesaid predefined microwave band, and, more conveniently, also a power amplification); and
- connected, through the Tx/Rx switch 13, to the antenna 11 to supply the latter with the RF signals to be transmitted.

[0044] Additionally, Figure 2 shows a block diagram schematically representing an architecture of a DRFM-based ECM system (denoted as a whole by 2) according to a specific preferred embodiment of the present inven-

tion.

[0045] In particular, the DRFM-based ECM system 2 is configured to operate in an ECM mode and also in a data link communications mode, and includes:

- an antenna 20, preferably an active phased array antenna, that is configured to receive and transmit RF signals having frequencies comprised in the aforesaid predefined microwave band;
- low-pass filtering means 21, that are
  - connected, through a Tx/Rx switch 22, to the antenna 20 to receive the RF signals received by said antenna 20, and
  - configured to carry out a low-pass filtering of said received RF signals (so as to increase signal-to-noise ratio (SNR)), thereby producing corresponding filtered RF signals;
- a DRFM 23, that is
  - coupled to a first ECM/communication switch 24 to be alternately connected,
    - when the DRFM-based ECM system 2 operates in the ECM mode, to the Tx/Rx switch 22 to receive the RF signals received by the antenna 20, or,
    - when the DRFM-based ECM system 2 operates in the data link communications mode, to the low-pass filtering means 21 to receive the filtered RF signals; and
  - configured to
    - convert the RF signals from the antenna 20 or the filtered RF signals from the low-pass filtering means 21 into digital format, thereby producing corresponding digital time samples; and,
    - when the DRFM-based ECM system 2 operates in the ECM mode,
      - store on a memory (not shown in Figure 2) the digital time samples,
      - process the stored digital time samples (for example, by performing a frequency and/or phase offset, and/or a frequency, phase and/or amplitude modulation, etc., for ECM purposes, in particular for radar jamming), and
      - convert the processed time samples into analog format, thereby producing ECM analog signals to be transmitted;
- a jamming control unit 25, that is connected to the DRFM 23 to receive the ECM analog signals to be transmitted, and that is configured to implement transmission thereof on the basis of a predefined jamming control logic;
- a digital demodulator 26, that is
  - connected to the DRFM 23 to receive therefrom, when the DRFM-based ECM system 2 operates in the data link communications mode, the digital time samples of the filtered RF signals, and
  - configured to carry out a predefined digital demodulation on the basis of the digital time samples received from the DRFM 23, so as to extract information symbols carried by said received digital time samples; and
- a digital modulator 27, that is configured to
  - carry out a predefined digital modulation by producing communication digital time samples which carry information symbols to be transmitted, and
  - convert the communication digital time samples into analog format, thereby producing communication analog signals to be transmitted;
- Tx means 28, that are
  - coupled to a second ECM/communication switch 29 to be alternately connected,
    - when the DRFM-based ECM system 2 operates in the ECM mode, to the jamming control unit 25 to receive the ECM analog signals, or,
    - when the DRFM-based ECM system 2 operates in the data link communications mode, to the digital modulator 27 to receive the communication analog signals; and
  - configured to
    - transform said ECM/communication analog signals to be transmitted into corresponding RF signals to be transmitted (conveniently by performing a frequency upshift to RFs comprised in the aforesaid predefined microwave band, and, more conveniently, also a power amplification), and
    - supply the antenna 20 (to which is connected through the Tx/Rx switch 22) with the RF signals to be transmitted.

[0046] In view of the foregoing, it is clear that the DRFM 23, the jamming control unit 25, the digital demodulator 26 and the digital modulator 27 represent a specific preferred mode to carry out the processing means 14 of the EW system 1 previously described.

[0047] Moreover, similarly to the EW system 1, also the predefined digital modulation and demodulation car-

ried out by the digital modulator 27 and demodulator 26 of the DRFM-based ECM system 2 can be any type of digital modulation/demodulation. In particular, also in this case, said the predefined digital modulation and demodulation can be conveniently based on one of the following digital modulation/demodulation techniques: ASK, APSK, CPM, FSK, MFSK, MSK, PSK, QAM, SC-FDMA, OFDM, CDMA modulation, or a spread spectrum modulation.

[0048] The advantages of the present invention are clear from the foregoing.

[0049] In particular, it is worth highlighting the fact that the present invention can be easily implemented by suitably configuring or reconfiguring the digital processing devices of EW systems of the ESM and/or ECM type to perform, in addition to one or more predefined ESM and/or ECM functions, also the aforesaid data link communications function. Specifically, this can be accomplished by simply loading suitable software and/or firmware programs onto embedded programmable processing devices, such as DSPs and/or FPGAs, of ESM and/or ECM systems.

[0050] Thence, the present invention represents an easy, low-cost solution to provide the EW systems of the ESM and/or ECM type, in particular also the existing ones, with high-data-rate data link communications capabilities, that can be used as an alternative to, or rather in addition to, the current military communication systems, such as TDLs, to enhance communication flexibility and also efficacy of cooperation and coordination of interconnected military systems, platforms, vehicles, aircrafts, naval units, etc..

[0051] Moreover, it is important to stress the point that the present invention does not entail any additional hardware to be installed on board military platforms, vehicles, aircrafts, naval units, etc., that are already overcrowded and that thus are not further burdened.

[0052] Furthermore, the preferred use of active phased array antennas (that, as is known, can simultaneously handle a plurality of signals thanks to their capability to quickly change antenna pointing) allows to:

- exploit the antenna for data link communications purposes for very short periods; and
- point the antenna, each time, at a respective military platform with which a respective data link communication is to be carried out, thereby rendering the data link communication very robust against any intentional or unintentional interference.

[0053] Additionally, the present invention allows also to share, among different interconnected systems, information items originating from each individual system, thereby improving quality of, and increasing quantity of, information items available to each individual system, for example for purposes of:

- enhanced picture compilation (for instance, in some cases an entity of special strategic or tactic importance might be "seen" by a system on a given platform, but not by another one);
- sharing with other platforms of high quality, or greater reliability, information items; and
- creation of a new, highly-secure, high-data-rate communication link for diffusion of tactical and strategic information items among many users.

[0054] In particular, the creation of a new, dedicated, highly-secure, high-data-rate communication link enables new applications based on coordination of multiple platforms, such as:

- advanced geolocalization techniques, for example based on triangulation and multilateration (in particular, the latter is very expensive in terms of bandwidth resources and may be virtually infeasible in the absence of a dedicated data link);
- advanced jamming techniques, such as "cooperative blinking jamming" techniques against monopulse radar systems (for example, two platforms equipped with jammers, by coordinating their emissions in a suitable and synchronized way by means of the present invention, can cause an enemy tracking radar to point at one another alternately, thereby causing the loss of tracking towards both);
- multi-system combined techniques for insertion of information signals in the existing data links;
- advanced techniques for threat-related information integration for an improved situational awareness; and
- techniques for integration of data from multiple platforms to improve the overall reliability (in fact, reliability would no longer relate to a single system, but to the overall system network).

[0055] Finally, the present invention enables also further applications that require transmission of large amounts of data, such as imagery and/or video data.

[0056] In conclusion, it is clear that numerous modifications and variants can be made to the present invention, all falling within the scope of the invention, as defined in the appended claims.

Claims

1. Electronic warfare system (1,2), configured to operate in an electronic warfare mode and comprising processing means (14), that are configured to:

   • receive an incoming analog signal;
   • convert the incoming analog signal into an incoming digital signal; and,
   • when the electronic warfare system (1,2) operates in said electronic warfare mode, perform a predefined electronic support measure or

countermeasure function on the basis of the incoming digital signal;

characterized in that said electronic warfare system (1,2) is further configured to operate in a data link communications mode, wherein the processing means (14) are further configured, when the electronic warfare system (1,2) operates in said data link communications mode, to perform a data link communications function by carrying out:

- a predefined digital demodulation on the basis of the incoming digital signal so as to extract information symbols carried by said incoming digital signal; and
- a predefined digital modulation by producing a communication digital signal carrying information symbols to be transmitted.

2. The electronic warfare system of claim 1, further comprising:

- an antenna (11,20), that is configured to receive and transmit radio frequency signals having frequencies comprised in a predefined microwave band;
  wherein the incoming analog signal in indicative of a radio frequency signal received by the antenna (11,20);
  and wherein the antenna (11,20) is operable to transmit a radio frequency signal indicative of the communication digital signal.

3. The electronic warfare system according to claim 1 or 2, wherein the processing means (14) are configured to:

- carry out a fast Fourier transform of the incoming digital signal thereby producing digital frequency samples; and,
- when the electronic warfare system (1,2) operates in said data link communications mode, carry out the predefined digital demodulation on the basis of the digital frequency samples so as to extract information symbols carried by said digital frequency samples.

4. The electronic warfare system according to claim 1 or 2, wherein the processing means (14) are configured, when the electronic warfare system (1,2) operates in said data link communications mode, to carry out the predefined digital demodulation on the basis of digital time samples of the incoming digital signal so as to extract information symbols carried by said digital time samples.

5. The electronic warfare system of claim 4, wherein the processing means include a digital radio frequency memory (23), a digital demodulator (26) and digital modulator (27);
wherein the digital radio frequency memory (23) is configured to:

- receive the incoming analog signal;
- convert said incoming analog signal into the incoming digital signal; and,
- when the electronic warfare system (2) operates in said electronic warfare mode, perform the predefined electronic support measure or countermeasure function on the basis of the incoming digital signal;

wherein the digital demodulator (26) is configured, when the electronic warfare system (2) operates in said data link communications mode, to:

- receive the digital time samples of the incoming digital signal from the digital radio frequency memory (23); and
- carry out the predefined digital demodulation on the basis of said digital time samples received from the digital radio frequency memory (23);

and wherein the digital modulator (27) is configured, when the electronic warfare system (2) operates in said data link communications mode, to carry out the predefined digital modulation by producing the communication digital signal.

6. The electronic warfare system of claim 5, further comprising:

- an antenna (20), that is configured to receive and transmit radio frequency signals having frequencies comprised in a predefined microwave band; and
- low-pass filtering means (21), that are connected through a transmit/receive switch (22) to the antenna (20) to receive the radio frequency signals received by said antenna (20), and that are configured to carry out a low-pass filtering of said received radio frequency signals thereby producing filtered radio frequency signals;

wherein the digital radio frequency memory (23) is coupled to a first electronic-countermeasure/communication switch (24) to be alternately connected:

- when the electronic warfare system (2) operates in said electronic warfare mode, to the transmit/receive switch (22) to receive the radio frequency signals received by the antenna (20); or,
- when the electronic warfare system (2) operates in said data link communications mode, to the low-pass filtering means (21) to receive the

filtered radio frequency signals;

wherein said digital radio frequency memory (23) is configured to:

• when the electronic warfare system (2) operates in said electronic warfare mode,

- receive a radio frequency signal received by the antenna (20),
- convert said received radio frequency signal into a first incoming digital signal,
- store digital time samples of said first incoming digital signal,
- process the stored digital time samples, and
- convert the processed digital time samples into analog format thereby producing an electronic countermeasure analog signal; and

• when the electronic warfare system (2) operates in said data link communications mode,

- receive a filtered radio frequency signal from the low-pass filtering means (21),
- convert said filtered radio frequency signal into a second incoming digital signal, and
- supply the digital demodulator (26) with digital time samples of said second incoming digital signal;

wherein the digital modulator (27) is configured, when the electronic warfare system (2) operates in said data link communications mode, to convert the communication digital signal into a communication analog signal;

wherein said electronic warfare system (2) further comprises:

• a jamming control unit (25), that is connected to the digital radio frequency memory (23) to receive the electronic countermeasure analog signal, and that is configured to implement transmission of said electronic countermeasure analog signal on the basis of a predefined jamming control logic; and
• transmission means (28), that are connected through the transmit/receive switch (22) to the antenna (20), and that are coupled to a second electronic-countermeasure/communication switch (29) to be alternately connected,

- when the electronic warfare system (2) operates in said electronic warfare mode, to the jamming control unit (25) to receive the electronic countermeasure analog signal, or,
- when the electronic warfare system (2) operates in said data link communications mode, to the digital modulator (27) to receive the communication analog signal;

and wherein the transmission means (28) are configured to:

• when the electronic warfare system (2) operates in said electronic warfare mode, transform the electronic countermeasure analog signal into an electronic countermeasure radio frequency signal and supply the antenna (20) with said electronic countermeasure radio frequency signal; and
• when the electronic warfare system (2) operates in said data link communications mode, transform the communication analog signal into a communication radio frequency signal and supply the antenna (20) with said communication radio frequency signal.

7. The electronic warfare system according to any claim 1-4, further comprising:

• an antenna (11), that is configured to receive and transmit radio frequency signals having frequencies comprised in a predefined microwave band; and
• pre-processing means (12), that are

- connected through a transmit/receive switch (13) to the antenna (11) to receive a radio frequency signal received by said antenna (11),
- configured to carry out a pre-processing of said received radio frequency signal thereby producing a pre-processed analog signal, and
- connected to the processing means (14) to supply the latter with said pre-processed analog signal;

wherein the processing means (14) are further configured to convert the communication digital signal into a communication analog signal;

and wherein said electronic warfare system (1) further comprises transmission means (18), that are:

• connected to the processing means (14) to receive therefrom the communication analog signal;
• configured to transform said communication analog signal into a communication radio frequency signal; and
• connected through the transmit/receive switch

(13) to the antenna (11) to supply the latter with the communication radio frequency signal.

8. The electronic warfare system according to claim 2 or 6 or 7, wherein the antenna (11,20) is an active phased array antenna.

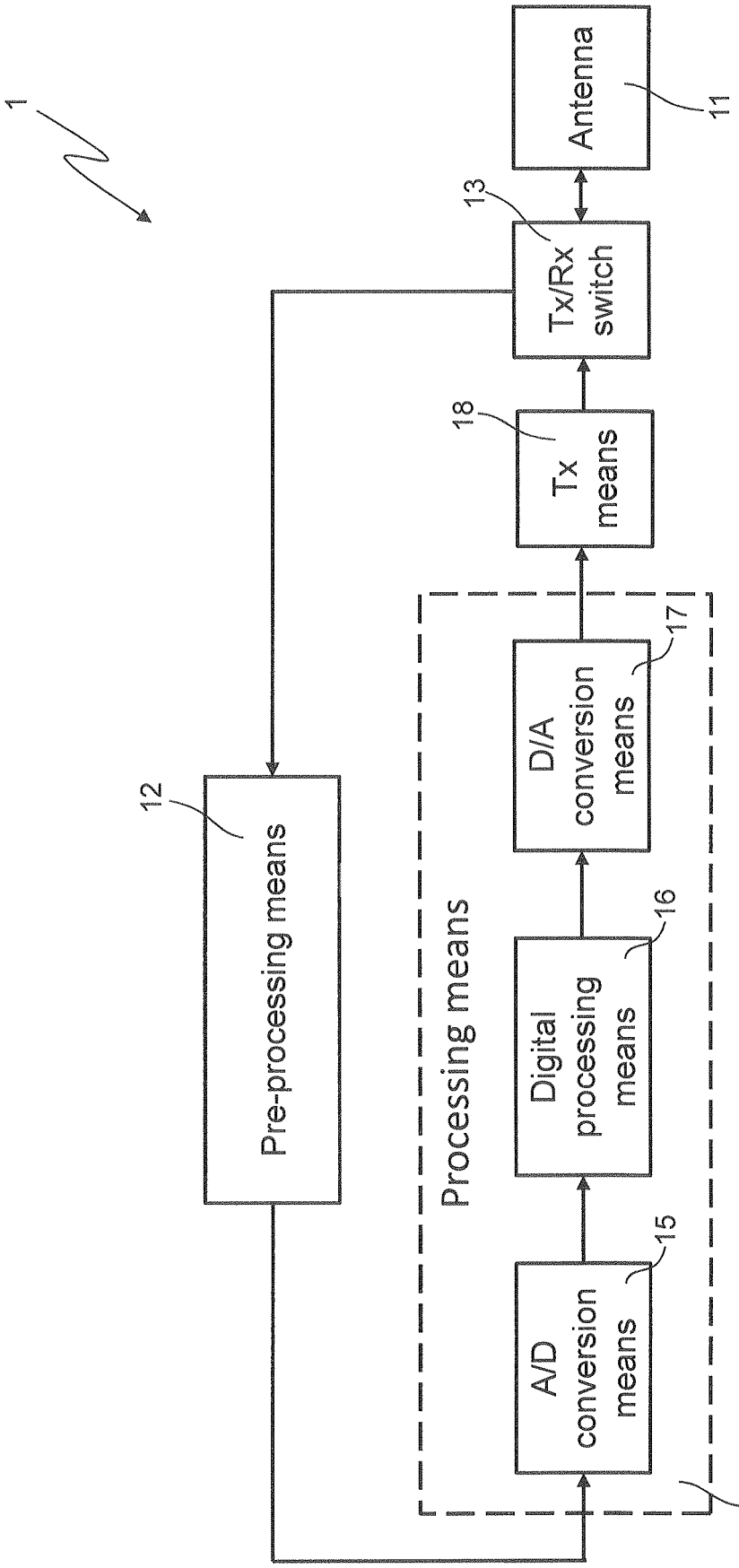
1
Antenna
11
13
Tx/Rx switch
18
Tx means
D/A conversion means
17
Processing means
Digital processing means
16
A/D conversion means
15
14
12
Pre-processing means

Fig. 1

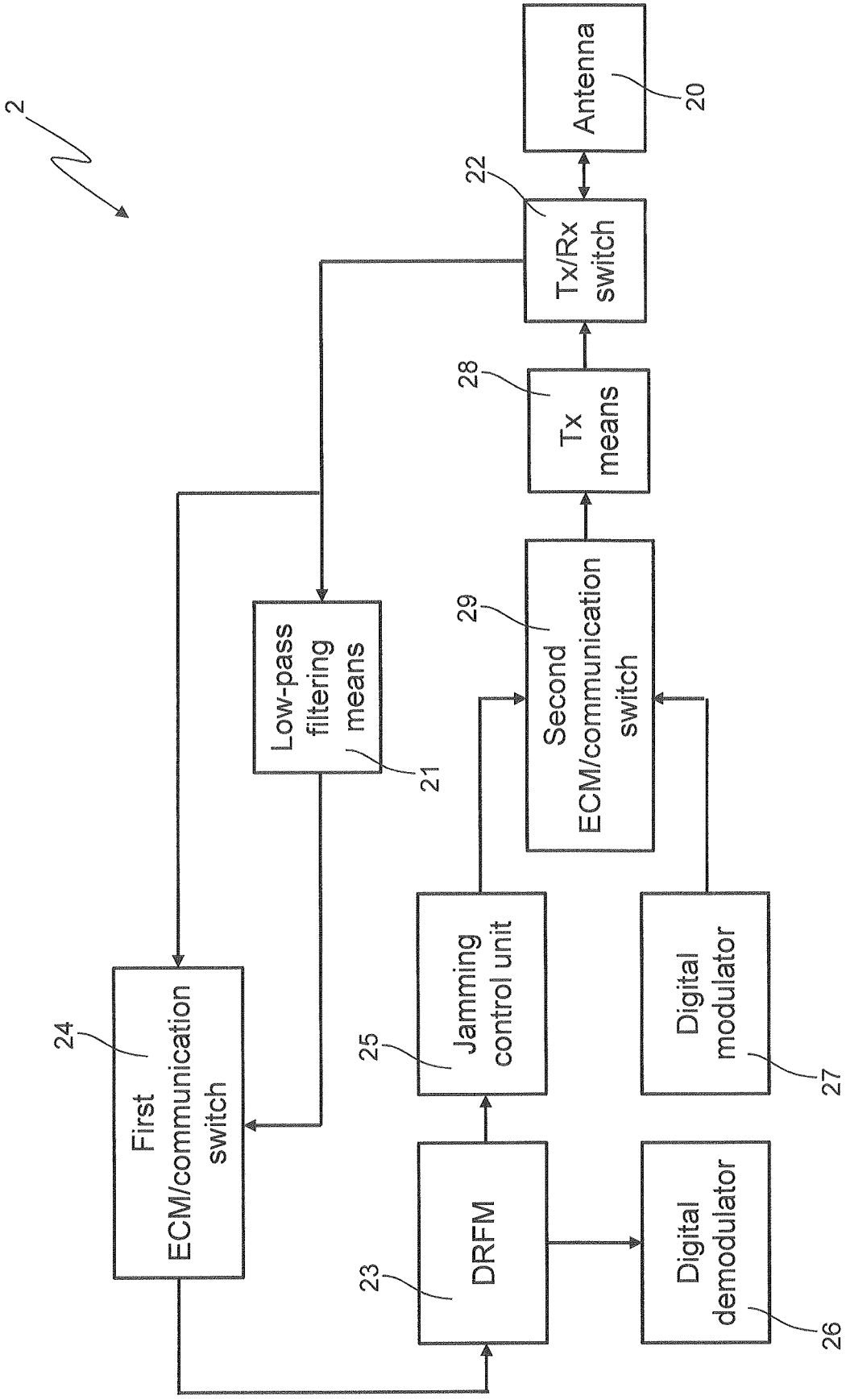
2
Antenna
20
22
Tx/Rx switch
28
Tx means
29
Second ECM/communication switch
Low-pass filtering means
21
First ECM/communication switch
24
Jamming control unit
25
Digital modulator
27
DRFM
23
Digital demodulator
26

Fig. 2

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EUROPEAN SEARCH REPORT

Application Number
EP 16 15 5600

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The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	12 October 2016	Dujardin, Corinne

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