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(54) **METHOD AND SYSTEM FOR JAMMING AN OFDM OPERATED UNMANNED AERIAL VEHICLE**

(57) The invention relates to a method of jamming an OFDM operated unmanned aerial vehicle (12), wherein the method comprises the steps of:
- Receiving at least one OFDM stream having several OFDM symbols by means of at least one receiver (16), thereby obtaining a received signal,
- Delaying the received signal by a delay time by means of at least one delay module (26), thereby generating a delayed signal,
- Forwarding the delayed signal to at least one transmitter (20), and
- Transmitting at least one part of the delayed signal by means of the transmitter (20), wherein the delayed signal is associated with the OFDM stream received, and wherein at least one cyclic prefix of an OFDM symbol is transmitted by the transmitter (20).

Furthermore, a system (10) for jamming an OFDM operated unmanned aerial vehicle (12) is described.

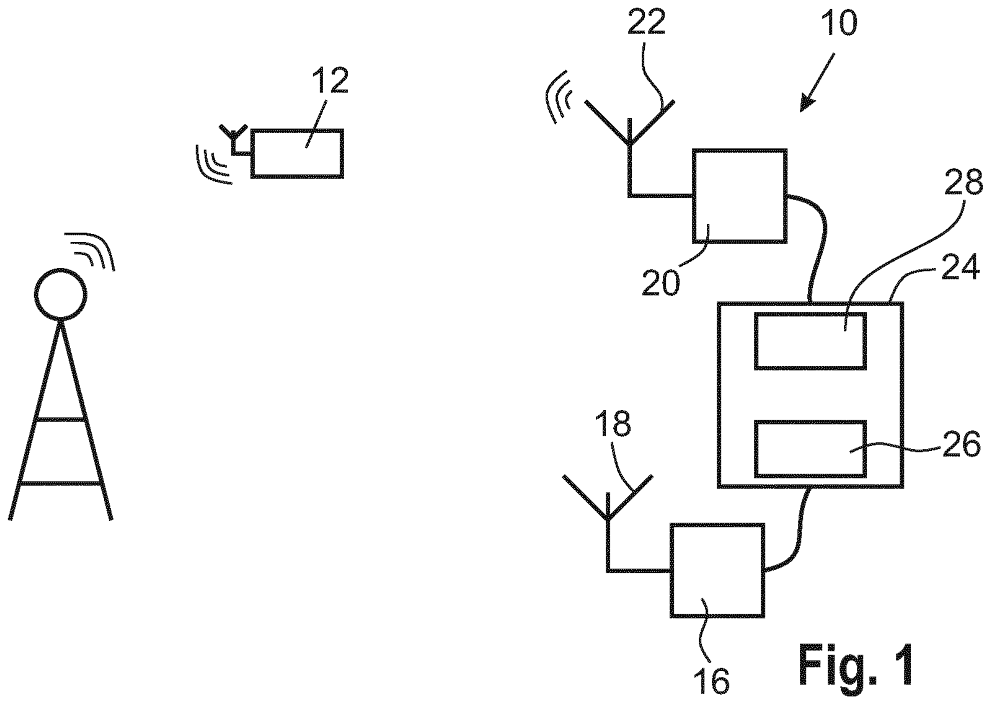

Fig. 1

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Description

[0001] The invention relates to a method of jamming an OFDM operated unmanned aerial vehicle (UAV). Further, the invention relates to a system for jamming an OFDM operated unmanned aerial vehicle (UAV).

[0002] In the past, unmanned aerial vehicles (UAVs) like aerial drones, for instance private controlled ones, become an increasing problem at airports, as they might disturb the operating processes at the airports. The unmanned aerial vehicles may penetrate the respective airspace, endangering airplanes during landing and/or take-off.

[0003] Further, using those unmanned aerial vehicles is also forbidden at other public places for security reasons. For instance, it is not allowed to operate unmanned aerial vehicles in an airspace assigned to an audience of an open-air concert, a festival or the like.

[0004] Typically, unmanned aerial vehicles are controlled by radio signals received from radio transmitters that emit the respective radio signals. Modern unmanned aerial vehicles may also be operated by using terrestrial cellular networks based on Orthogonal Frequency-Division Multiplexing (OFDM) techniques. For instance, 4G or rather 5G mobile communications may be used for controlling the unmanned aerial vehicles (UAVs).

[0005] In any case, a modern unmanned aerial vehicle (UAV) corresponds to a signal receiver for the respective signals emitted by at least one signal emitter of the respective type.

[0006] As mentioned above, operating unmanned aerial vehicles is restricted and, thus, it might be important to prevent the operation of these unmanned aerial vehicles at certain areas. Typically, this is done by jamming the respective communication signals by means of chirp signals having relatively high power in order to superimpose the real control signals such that the respective signal receiver, namely the unmanned aerial vehicle, receives the jamming signal instead of the real control signal.

[0007] However, besides the unmanned aerial vehicles not allowed to be operated at certain areas such as third-party unmanned aerial vehicles, other devices might be allowed to be operated which, however, use the same kind of signals. Accordingly, it is also important that those devices are robust against jamming or rather that they are not disturbed.

[0008] Accordingly, there is a need for a method and a system which ensure to prevent an unmanned aerial vehicle to be operated in a certain area while not disturbing other unmanned aerial vehicles allowed to be operated in the respective area.

[0009] The invention provides a method of jamming an OFDM operated unmanned aerial vehicle. The method comprises the steps of:

- receiving at least one OFDM stream having several OFDM symbols by means of at least one receiver, thereby obtaining a received signal,
- delaying the received signal by a delay time by means of at least one delay module, thereby generating a delayed signal,
- forwarding the delayed signal to at least one transmitter, and
- transmitting at least one part of the delayed signal by means of the transmitter, wherein the delayed signal is associated with the OFDM stream received, and wherein at least one cyclic prefix of an OFDM symbol is transmitted by the transmitter.

[0010] Accordingly, a mechanism for jamming an unmanned aerial vehicle such as an aerial drone is provided, which does not cause interference to other users or rather unmanned aerial vehicles in the same area. The invention ensures to selectively jam a certain unmanned aerial vehicle that is not permitted to enter the respective area controlled. In fact, a radio signal used by the unmanned aerial vehicle for communication purposes is jammed by means of the method, wherein the unmanned aerial vehicle is operated by a terrestrial cellular network that uses a cellular system based on OFDM techniques.

[0011] In general, the cyclic prefix has two main functions, as if provides a guard interval to eliminate intersymbol interference of neighbored OFDM symbols. Further, the cyclic prefix repeats the end of the OFDM symbol. Hence, a linear convolution of a frequency-selective multipath channel can be modeled as a circular convolution, thereby enabling simple frequency domain processing like channel estimation and equalization. In fact, each cyclic prefix is created such that each OFDM symbol is preceded by a copy of the end part of that symbol (itself).

[0012] The OFDM symbols of an OFDM stream used for communication is typically composed by starting from a base modulation of Binary Phase Shift Keying (BPSK), Quadrature Phase-Shift Keying (QPSK) or rather Quadrature Amplitude Modulation (QAM), going through an Inverse Fast Fourier Transform (IFFT), and then attaching the cyclic prefix (CP) to the respective OFDM symbol, particularly its beginning.

[0013] The respective receiver, namely the one of the unmanned aerial vehicle or rather the base station, takes N samples of the OFDM stream received, wherein N corresponds to the radix of a Fast Fourier Transform (FFT). A start point has to be somewhere inside the cyclic prefix (CP). After performing the FFT, the demodulation may take place in order to arrive at the demodulated information. Between the FFT phase and BPSK/QPSK/QAM demodulation phase, a channel equalization algorithm is performed that flattens a channel response and zeros the channel phase response. Then, the respective constellation points of the modulation are the expected ones irrespective of noise introduced during demodulation.

[0014] For instance, only a fraction of the respective OFDM symbol is transmitted, namely the respective cyclic prefix.

[0015] Generally, several cyclic prefixes associated with several OFDM symbols are transmitted. Hence, only the respective fractions of the OFDM symbols are transmitted.

[0016] When jamming the OFDM operated unmanned aerial vehicle, the unmanned aerial vehicle may be forced to land or rather to autonomously return to its operator, wherein the respective scenario depends on the kind of jamming performed when transmitting the at least one part of the delayed signal that is associated with the OFDM stream received previously.

[0017] In other words, the at least one part of the delayed signal that is transmitted is used to corrupt or rather confuse a receiver of the unmanned aerial vehicle and/or a receiver of a base station communicating with the unmanned aerial vehicle (UAV).

[0018] For instance, the base station that communicates with the unmanned aerial vehicle receives the at least one part of the delayed signal which makes the base station believe that the unmanned aerial vehicle (UAV) is moving in a certain manner which is not true, as the transmitted part of the delayed signal is false and, therefore, the transmitted part of the delayed signal confuses the base station.

[0019] The corruption of the communication between the unmanned aerial vehicle and the base station may yield the unmanned aerial vehicle to lose connection with the base station, thereby enabling security procedures of the unmanned aerial vehicle like landing or rather returning to its operator.

[0020] Accordingly, the invention is based on the finding that the OFDM stream used for communication between the unmanned aerial vehicle and the base station is received and processed, namely by delaying the received signal. Then, the delayed signal is transmitted with the intension of disrupting the communication between the unmanned aerial vehicle and the base station communicating with the unmanned aerial vehicle.

[0021] However, only a beginning portion of the OFDM stream received is transmitted by the system instead of the whole signal/stream received, for instance a first half of the entire OFDM stream received.

[0022] Generally, it is ensured that other users or rather unmanned aerial vehicles in neighboring time slots on the same channel are not disturbed or suffer unnecessary interference from the jamming when transmitting only a part of the entire OFDM stream received. Hence, only the targeted unmanned aerial vehicle is jammed efficiently.

[0023] Accordingly, only a part, particularly the first part, of the delayed signal is transmitted rather than the entire delayed signal that corresponds to the OFDM stream received. In any case, the cyclic prefix of a respective OFDM symbol is transmitted.

[0024] Generally, the method applies in both directions, namely downlink direction as well as uplink direction. The originally received OFDM stream is partly transmitted with a delay based on the delay time, which leads to an interference such that an existing communication channel might be dropped by the unmanned aerial vehicle. When dropping the communication channel, the unmanned aerial vehicle is typically forced to land or autonomously return to its operator due to security procedures applied.

[0025] An aspect provides that the delay time is set manually or automatically based on an operation mode. In other words, the delay time is set depending on a respective scenario how to jam the communication between the unmanned aerial vehicle and the base station. The delay time may be set manually by an operator or rather automatically based on a certain operation mode that is selected. The operation mode may concern a corruption, stealthy jamming or rather confusion.

[0026] Another aspect provides that the delay time is variable. In fact, the delay time may be constant during the respective jamming, but different depending on the respective operation mode selected. Further, the delay time may vary during a certain operation mode such that the delay time increases or rather decreases over time depending on the respective scenario applied. In addition, the operator of the system may set a ramping of the delay time, thereby increasing or rather decreasing the delay time during the jamming according to a certain setting or rather function, for instance linear over time.

[0027] In addition, the delay time may be chosen such that a higher transmit power of the OFDM operated unmanned aerial vehicle is set, thereby faster draining a battery of the OFDM operated unmanned aerial vehicle. The respective delay time may make the base station believe that the unmanned aerial vehicle is moving away from the base station, which in turn requests the unmanned aerial vehicle to increase its transmit power yielding a higher battery consumption such that the battery of the OFDM operated unmanned aerial vehicle drains faster. In fact, security procedures of the unmanned aerial vehicle are initiated earlier due to the reduced battery power, forcing the unmanned aerial vehicle to land or rather return to its operator.

[0028] Generally, the unmanned aerial vehicle may also be forced to repetitively transmit communication signals in order to establish a communication with the base station, thereby draining the battery of the OFDM operated unmanned aerial vehicle faster. Accordingly, the security procedures of the unmanned aerial vehicle are initiated earlier due to the reduced battery power.

[0029] In addition, the higher transmit power or rather the repetitive transmission of signals may relate to a Wireless Local Area Network (WLAN) mode. Hence, the battery is drained faster without allowing the operator of the unmanned aerial vehicle to realize that the unmanned aerial vehicle is jammed in this way. Accordingly, the operator of the unmanned aerial vehicle only believes that the battery consumption of the unmanned aerial vehicle is high without realizing that the unmanned aerial vehicle has been attacked.

[0030] Moreover, the delay time may be increased over time. The transmission of the part of the delayed signal may start from a low delay that is increased over time, which may result in a stealthy jamming of the unmanned aerial vehicle. It is assumed that the unmanned aerial vehicle adapts its internal equalization algorithm to the part of the delayed signal transmitted, wherein the delay time is increased over time until the signal occurs after an ideal demodulation start point, thereby becoming interference.

[0031] In other words, the unmanned aerial vehicle receives two signals, namely the true one from the base station as well as the partial signal that is transmitted in order to jam the base station signal. The part of the delayed signal is transmitted such that the unmanned aerial vehicle incorrectly lock onto that signal transmitted instead of the correct one of the base station, thereby providing the stealthy jamming. In a similar manner, the base station receives two signals, namely the true one from the unmanned aerial vehicle as well as the part of the delayed signal that is transmitted in order to jam the communication between the unmanned aerial vehicle and the base station.

[0032] For instance, the delay time is up to three quarters of an OFDM symbol interval. Generally, the delay time depends upon how much of the OFDM stream received is to be transmitted for jamming the communication.

[0033] Another aspect provides that the part of the delayed signal is transmitted with a certain power set by means of a power adjustment module. Accordingly, the transmission time via the respective delay time as well as the transmission power of the transmitted part of the delayed signal can be set appropriately in order to effectively jam the communication between the unmanned aerial vehicle and the base station.

[0034] Particularly, the power of the part of the delayed signal may be variable. Hence, the power may be set due to a certain operation mode applied or rather being varied during a certain operation mode. In other words, the power may be constant in the respective operation mode, but the respective power may be different for different operation modes. Moreover, the power may vary during a certain operation mode. Accordingly, the power may increase or rather decrease during the jamming according to a certain operation mode applied.

[0035] For instance, the power of the part of the delayed signal is increased over time. Therefore, the transmission could start as a low power signal to which the unmanned aerial vehicle adapts its equalization algorithm, wherein the power (together with the delay) is increased until the transmitted part of the delayed signal occurs after the ideal demodulation start point, thereby becoming interference for the real (control) signal.

[0036] The received signal may be demodulated, thereby obtaining I/Q components associated with the OFDM stream, wherein at least one of the I/Q components is inverted, thereby generating inverted I/Q components which are modulated, thereby generating an inverted signal. Therefore, one of the orthogonal channels used for communication between the unmanned aerial vehicle and the base station based on OFDM techniques is inverted in order to throw the respective communications into disarray. Again, the communication between the unmanned aerial vehicle and the base station is disturbed.

[0037] The inverted signal may be delayed afterwards. Therefore, the demodulation takes place prior to delaying the signal. Alternatively, the signal may be delayed firstly and inverted afterwards, thereby generating the delayed signal.

[0038] In any case, the part of the signal transmitted may correspond to a delayed signal with respect to the originally received OFDM stream, wherein the delayed signal is transmitted over an inverted channel with respect to the one used for transmitting the original OFDM stream.

[0039] The invention further provides a system for jamming an OFDM operated unmanned aerial vehicle. The system comprises at least one receiver, a delay module and at least one transmitter. The delay module is connected with the at least one receiver and the at least one transmitter. The receiver is configured to receive at least one OFDM stream having several OFDM symbols, thereby obtaining a received signal. The delay module is configured to delay the received signal by a delay time, thereby generating a delayed signal. The transmitter is configured to transmit at least one part of the delayed signal that is associated with the OFDM stream received. The transmitter is configured to transmit at least one cyclic prefix of an OFDM symbol.

[0040] In fact the system is configured to perform a method of jamming an OFDM operated unmanned aerial vehicle as described above.

[0041] The same advantages and characteristics apply in a similar manner to the system.

[0042] An aspect provides that a reception antenna is associated with the at least one receiver and/or wherein a transmission antenna is associated with the at least one transmitter. The receiver and/or the transmitter are/is configured to receive/transmit radio frequency signal that are converted into electrical signals for further processing by means of the respective antenna.

[0043] In addition, the system may further comprise a power adjustment module that is configured to set the power of the part of the delayed signal transmitted. The power adjustment module is used to vary the respective power of the part of the delayed signal transmitted, thereby confusing the respective receiver of the unmanned aerial vehicle or rather the base station.

[0044] Another aspect provides that the at least one receiver is a full duplex receiver and/or wherein the at least one transmitter is a full duplex transmitter. Generally, an in-band full-duplex (FDX) system allows communication in both directions simultaneously. In fact, the receiver/transmitter uses in-band full-duplex (IBFD) technology which allows simultaneous transmission and reception in the same frequency band, increasing the throughput. Accordingly, inherent self-interference cancellation may be provided by the receiver/transmitter.

[0045] Further aspects and advantages of the claimed subject matter will become more readily appreciated as the same become better understood by reference to the following detailed description, when taken in conjunction with the accompanying drawings. In the drawings,

- Figure 1 schematically shows a system for jamming an OFDM operated unmanned aerial vehicle according to the invention,

- Figure 2 schematically shows an overview concerning the composition of an OFDM symbol, and

- Figure 3 schematically shows a flow-chart illustrating a method of jamming an OFDM operated unmanned aerial vehicle according to the invention.

[0046] The detailed description set forth below in connection with the appended drawings, where like numerals reference like elements, is intended as a description of various embodiments of the disclosed subject matter and is not intended to represent the only embodiments. Each embodiment described in this disclosure is provided merely as an example or illustration and should not be construed as preferred or advantageous over other embodiments. The illustrative examples provided herein are not intended to be exhaustive or to limit the claimed subject matter to the precise forms disclosed.

[0047] For the purposes of the present disclosure, the phrase "at least one of A, B, and C", for example, means (A), (B), (C), (A and B), (A and C), (B and C), or (A, B, and C), including all further possible permutations when greater than three elements are listed. In other words, the term "at least one of A and B" generally means "A and/or B", namely "A" alone, "B" alone or "A and B".

[0048] In Figure 1, a system 10 for jamming an OFDM operated unmanned aerial vehicle 12 that communicates with a base station 14 over a terrestrial cellular network using a cellular system based on OFDM.

[0049] The system 10 comprises at least one receiver 16 that is associated with a reception antenna 18 as well as at least one transmitter 20 that is associated with a transmission antenna.

[0050] The receiver 16 and/or the transmitter 20 may be established as full duplex ones, namely full duplex receiver or rather full duplex transmitter. Accordingly, the respective receiver 16 and/or transmitter 20 may relate to in-band full duplex systems for self-interference cancellation.

[0051] In addition, the system 10 comprises a processing component 24 that is connected with the receiver 16 as well as the transmitter 20.

[0052] The processing module 24 comprises a delay module 26 as well as a power adjustment module 28.

[0053] In general, the system 10 shown in Figure 1 is enabled to perform a method of jamming the OFDM operated unmanned aerial vehicle 12 as schematically illustrated in Figure 3 to which reference is made later.

[0054] In Figure 2, an overview is shown that schematically shows how an OFDM symbol of an OFDM stream used for communication between the unmanned aerial vehicle 12 and the base station 14 is generated.

[0055] The OFDM symbol being a signal part of the OFDM stream is generated based on modulating information, for instance I/Q data associated with the information. Then, a modulation takes place, for instance according to Binary Phase Shift Keying (BPSK), Quadrature Phase-Shift Keying (QPSK) or rather Quadrature Amplitude Modulation (QAM). Afterwards, an Inverse Fast Fourier Transform (IFFT) is applied, wherein a cyclic prefix (CP) is attached to the OFDM symbol, namely to its beginning as illustrated in Figure 2.

[0056] At receiving side, namely the unmanned aerial vehicle 12 or rather the base station 14, N samples of the OFDM signal are taken into account by the respective receiving device, where N is the radix of the FFT, and wherein the start point is located within the cyclic prefix as illustrated in Figure 2. Then, a demodulation is done after performing the Fast Fourier Transform (FFT), thereby arriving at the demodulated information.

[0057] For jamming the OFDM operated unmanned aerial vehicle 12, the receiver 16 receives at least one OFDM stream with several OFDM symbols in a first step S1 as shown in Figure 3.

[0058] The OFDM stream is used for communication between the unmanned aerial vehicle 12 and the base station 14. In fact, the OFDM stream may relate to an uplink stream or rather downlink stream such that communication in both direction may be jammed by means of the system 10 efficiently.

[0059] The receiver 16 receives the OFDM stream via its antenna 18, thereby generating or rather obtaining a received signal that is processed further internally by means of the processing component 24.

[0060] In a second step S2, the received signal is delayed by a delay time by means of the delay module 26, thereby generating a delayed signal.

[0061] The delayed signal is forwarded to the at least one transmitter 20 via the processing component 24 in a third step S3.

[0062] In a fourth step S4, the transmitter 20 transmits at least one part of the delayed signal that is associated with the OFDM stream received originally by means of the receiver 16.

[0063] In fact, the transmitter 20 transmits at least one cyclic prefix (CP) of an OFDM symbol in order to jam the OFDM operated unmanned aerial vehicle 12 that receives the at least one part of the delayed signal, namely the at least one cyclic prefix of the OFDM symbol.

[0064] Generally, the part of the delayed signal may correspond to a beginning part of the whole OFDM stream/signal received, for example the first half of the entire duration.

[0065] Moreover, only a fraction of the respective OFDM symbol(s) is transmitted, namely the respective cyclic prefix.

[0066] Besides the delay module 26, the processing component 24 may also adapt the power of the delayed signal by means of the power adjustment module 28.

[0067] Moreover, the processing component 24 is also enable to demodulate the OFDM stream received, namely the received signal, thereby obtaining I/Q components associated with the OFDM stream.

[0068] Further, the processing component 24 is enabled to invert at least one of the I/Q components, particularly the Q component, thereby generating inverted I/Q components which are modulated afterwards, thereby generating an inverted signal. In fact, one of the orthogonal channels could be inverted such that the communication between the unmanned aerial vehicle 12 and the base station 14 is thorn into disarray.

[0069] The power adaption and/or inversion may be done in a fifth step S5 that may take place prior or after the delay applied by means of the delay module 26.

[0070] Therefore, the processing component 24 may provide a signal that is delayed as well as adapted in power and/or inverted.

[0071] Generally, it is ensured that the unmanned aerial vehicle 12 is jammed efficiently in order to corrupt or rather confuse the communication between the unmanned aerial vehicle 12 and the base station 14.

[0072] The respective delay time and/or power may be set manually by an operator of the system 10 or rather automatically by an operation mode selected, as the delay time and/or the power of the part of the delayed signal are/is variable.

[0073] For instance, the delay time may last up to three quarters of the OFDM symbol interval, depending on how much of the OFDM stream/signal is to be transmitted by the system 10.

[0074] The delay time and/or the power may be increased over time, thereby ensuring that the unmanned aerial vehicle 12 lock onto the transmitted part of the signal of the system 10 instead of the real signal transmitted by the base station 14 such that the system 10 takes over control of the unmanned aerial vehicle 12.

[0075] Further, the delay time set by the delay module 26 may be chosen such that a higher transmit power of the OFDM operated unmanned aerial vehicle 12 is requested by the base station 14, which is set in the unmanned aerial vehicle 12 accordingly. This results in a faster draining of a battery of the unmanned aerial vehicle 12 such that the unmanned aerial vehicle 12 has to return to its operator or rather land earlier due to a higher powered consumption.

[0076] The delay time is increased over time, thereby simulating a movement of the unmanned aerial vehicle 12 away from the base station 14, which makes the base station 14 believe that a higher transmit power of the OFDM operated unmanned aerial vehicle 12 is necessary for maintaining the communication appropriately.

[0077] In any case, the system 10 as well as the method of jamming an OFDM operated unmanned aerial vehicle 12 ensure that only the targeted unmanned aerial vehicle 12 is jammed efficiently due to transmitting the at least one part of the delayed signal rather than the whole signal received, wherein at least one cyclic prefix of the respective OFDM symbol is transmitted by the transmitter 20.

[0078] In general, the OFDM stream/signal is received and processed, wherein a beginning portion of the OFDM stream/signal is re-transmitted with a programmable delay and optionally a programmable power with the intention of disrupting the communication between the unmanned aerial vehicle 12 and the base station 14. Accordingly, only the beginning portion of the OFDM stream/signal is (re-)transmitted, for example the first half of the OFDM stream/signal, rather than the entire OFDM stream/signal.

[0079] Accordingly, only a fraction of the respective OFDM symbol(s) is transmitted, thereby ensuring that other user in neighboring timeslots on the same channel are not disturbed by the system 10. Accordingly, only the targeted receiver is jammed, namely the unmanned aerial vehicle 12 or rather the base station 14.

[0080] When starting from a low power and small time delay, stealthy jamming may be established appropriately. Thus, the respective transmission does not have to be sudden, but it may start as a low power signal with a small time delay such that the unmanned aerial vehicle 12 adapts its equalization algorithms to the part of the signal transmitted by the system 10. Then, the power and delay time are increased slowly until the part of the signal occurs after the ideal demodulation start point, thereby becoming interference. In other words, the unmanned aerial vehicle 12 receives two signals, namely the one of the system 10 as well as the correct one of the base station 14, wherein both signal superimpose with each other such that the unmanned aerial vehicle 12 may incorrectly lock onto the part of the signal provided by the system 10.

[0081] Generally, the method and system 10 lead to interference such that the respective communication channel is dropped, thereby causing the unmanned aerial vehicle 12 to land or autonomously return back to its operator.

[0082] In case of re-broadcasting the entire OFDM symbol(s), a side attack mechanism could be implemented for fooling the base station 14 while pretending a certain movement of the unmanned aerial vehicle 12.

[0083] Initially, there would be zero delay and zero power, wherein the power is increased firstly such that it is higher than the one of the unmanned aerial vehicle 12. Then, the delay time is increased. Accordingly, the base station 14 will respond by requesting the unmanned aerial vehicle 12 to adjust timing, and eventually the communication link will break as the unmanned aerial vehicle 12 would transmit too early.

[0084] In any case, a method and a system 10 are provided which ensure to prevent the unmanned aerial vehicle 12 to be operated in a certain area while not disturbing other unmanned aerial vehicles allowed to be operated in the respective area.

Claims

1. A method of jamming an OFDM operated unmanned aerial vehicle (12), wherein the method comprises the steps of:

- Receiving at least one OFDM stream having several OFDM symbols by means of at least one receiver (16), thereby obtaining a received signal,
- Delaying the received signal by a delay time by means of at least one delay module (26), thereby generating a delayed signal,
- Forwarding the delayed signal to at least one transmitter (20), and
- Transmitting at least one part of the delayed signal by means of the transmitter (20), wherein the delayed signal is associated with the OFDM stream received, and wherein at least one cyclic prefix of an OFDM symbol is transmitted by the transmitter (20).

2. The method according to claim 1, wherein the delay time is set manually or automatically based on an operation mode.

3. The method according to claim 1 or 2, wherein the delay time is variable.

4. The method according to any of the preceding claims, wherein the delay time is chosen such that a higher transmit power of the OFDM operated unmanned aerial vehicle (12) is set, thereby faster draining a battery of the OFDM operated unmanned aerial vehicle (12).

5. The method according to any of the preceding claims, wherein the delay time is increased over time.

6. The method according to any of the preceding claims, wherein the delay time is up to three quarters of an OFDM symbol interval.

7. The method according to any of the preceding claims, wherein the part of the delayed signal is transmitted with a certain power set by means of a power adjustment module (28).

8. The method according to claim 7, wherein the power of the part of the delayed signal is variable.

9. The method according to claim 7 or 8, wherein the power of the part of the delayed signal is increased over time.

10. The method according to any of the preceding claims, wherein the received signal is demodulated, thereby obtaining I/Q components associated with the OFDM stream, and wherein at least one of the I/Q components is inverted, thereby generating inverted I/Q components which are modulated, thereby generating an inverted signal.

11. The method according to claim 10, wherein the inverted signal is delayed afterwards.

12. A system for jamming an OFDM operated unmanned aerial vehicle (12), wherein the system (10) comprises at least one receiver (16), a delay module (26) and at least one transmitter (20), wherein the delay module (26) is connected with the at least one receiver (16) and the at least one transmitter (20), wherein the receiver (16) is configured to receive at least one OFDM stream having several OFDM symbols, thereby obtaining a received signal, wherein the delay module (26) is configured to delay the received signal by a delay time, thereby generating a delayed signal, wherein the transmitter (20) is configured to transmit at least one part of the delayed signal that is associated with the OFDM stream received, and wherein the transmitter (20) is configured to transmit at least one cyclic prefix of an OFDM symbol.

13. The system according to claim 12, wherein a reception antenna (18) is associated with the at least one receiver (16) and/or wherein a transmission antenna (12) is associated with the at least one transmitter (20).

14. The system according to claim 12 or 13, wherein the system (10) further comprises a power adjustment module (28) that is configured to set the power of the part of the delayed signal transmitted.

15. The system according to any of claims 12 to 14, wherein the at least one receiver (16) is a full duplex receiver and/or wherein the at least one transmitter (20) is a full duplex transmitter.

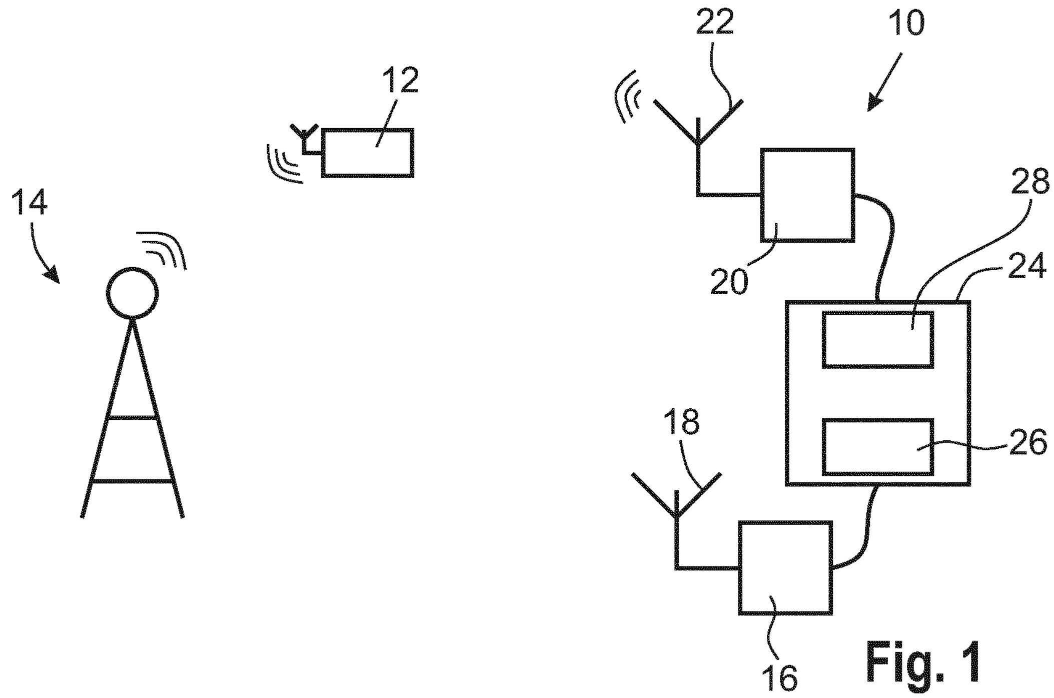
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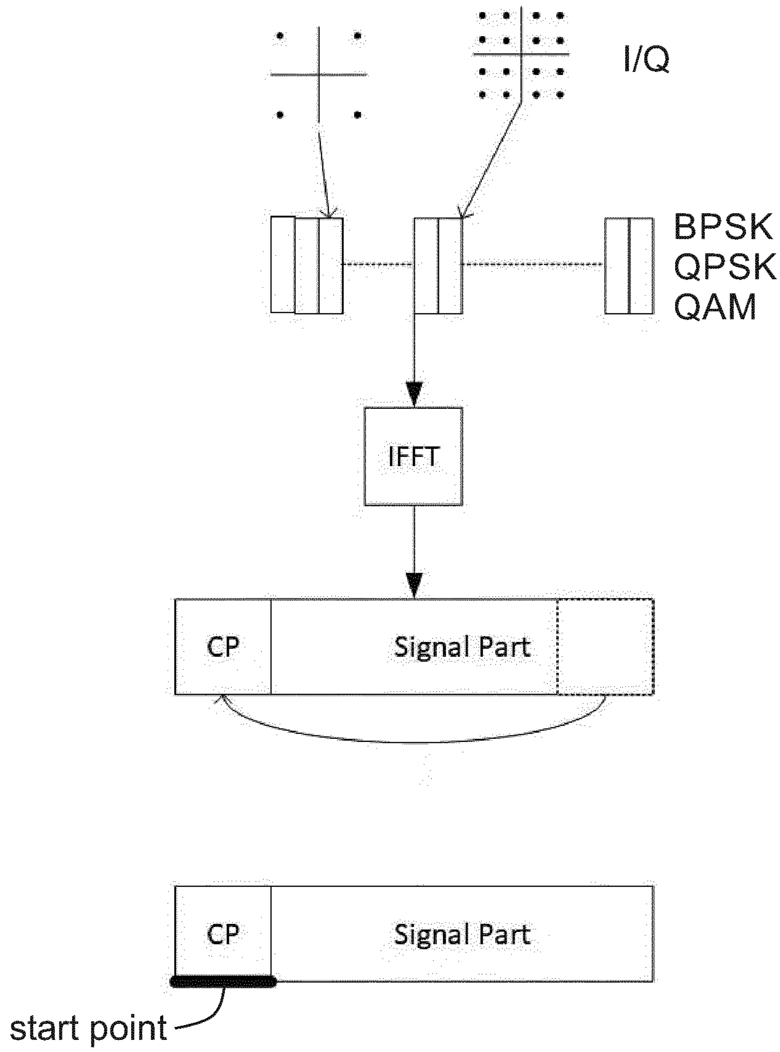
Fig. 1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CP
Signal Part
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Fig. 2

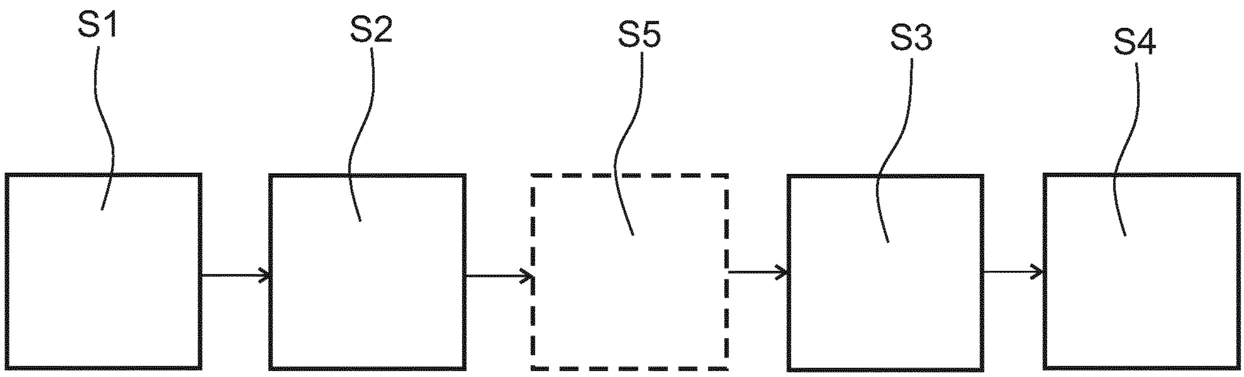

Fig. 3

Europäisches Patentamt
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EUROPEAN SEARCH REPORT

Application Number
EP 20 19 6494

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	US 2017/094527 A1 (SHATTIL STEVE [US] ET AL) 30 March 2017 (2017-03-30) * abstract * * paragraph [0003] - paragraph [0011] * * paragraph [0024] - paragraph [0149] * * figures 1-6 * -----	1-15	INV. H04K3/00
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The present search report has been drawn up for all claims

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Place of search	Date of completion of the search	Examiner
The Hague	26 February 2021	Dujardin, Corinne

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EUROPEAN SEARCH REPORT

Application Number
EP 20 19 6494

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