Claims

1. A computer-implemented method of controlling a gimbal stabilisation system of an aircraft in an antenna test system for testing an antenna under test, AUT, the gimbal stabilisation system comprising a control assembly rotatably coupled to a gimbal assembly comprising a payload, the payload comprising a first section including a communication sensor interface for use in testing the AUT and a second section rotatably coupled to the gimbal assembly, the control assembly comprising a controller, the method, performed by the controller, further comprising:

receiving an in-flight position of the aircraft during testing of the AUT;

receiving a position of the AUT in relation to the aircraft; and

controlling the gimbal assembly by:

calculating a pointing direction and alignment of the first section of the payload relative to the AUT based on the received position of the aircraft and the received position of the AUT; and

maintaining pointing and alignment of the first section of the payload towards the AUT based on the calculated pointing direction and alignment of the first section of the payload.

2. The computer-implemented method of claim 1, wherein receiving the in-flight position of the aircraft further comprising receiving data representative of global positioning system, GPS, position, heading, altitude and/or attitude of the aircraft.

3. The computer-implemented method of claims 1 or 2, further comprising receiving the position of the AUT further comprising receiving data representative of information associated with the position of the AUT.

4. The computer-implemented method of any of claims 1 to 3, wherein the communication sensor interface further comprises at least one from the group of:

a receiver;

a transmitter;

a transceiver;

and/or any other communication interface and/or communication sensor interface configured for testing the AUT.

5. The computer-implemented method of any preceding claim, further comprising controlling the pointing and/or alignment of the payload about at least two axes of rotation, wherein the control assembly is rotatably coupled to the gimbal assembly and the payload is rotatably coupled to the gimbal assembly.

6. The computer-implemented method of any preceding claim, further comprising controlling the pointing and/or alignment of the payload about at least three axes of rotation, wherein the control assembly is rotatably coupled to the gimbal assembly, the payload is rotatably coupled to the gimbal assembly, wherein the gimbal assembly includes a further axis of rotation for use in controlling the pointing and/or alignment of the payload.

7. The computer-implemented method of any of claims 1 to 6, wherein the control assembly is rotatably coupled to the gimbal assembly by a first motor, the gimbal assembly further comprising:

a first rotating arm coupled to the first motor, the first motor configured to rotate the first rotating arm around a first axis of rotation, the first rotating arm coupled to a second motor at an end of the first rotating arm distal to the coupling of the first rotating arm to the first motor;

a second rotating arm coupled to the second motor, the second motor configured to rotate the second rotating arm around a second axis of rotation, the second axis of rotation orthogonal to the first axis of rotation, the second rotating arm coupled to a third motor, wherein the third motor is configured to rotate the payload coupled to the third motor at the second section of the payload about a third axis of rotation, wherein the third axis of rotation is different to the second axis of rotation; and

the controller of the control assembly electrically connected to the first motor, the second motor and third motor;

wherein controlling the gimbal assembly further comprising:

maintaining pointing and alignment of the first section of the payload further comprising controlling one or more of the first motor, second motor, and third motors based on the calculated pointing direction and alignment of the first section of the payload towards the AUT.

8. The computer-implemented method of claim 7, wherein the first axis of rotation is a yaw axis of rotation in relation to the gimbal assembly, the second axis of rotation is a pitch axis of rotation in relation to the gimbal assembly, and the third axis of rotation is a roll axis of rotation in relation to the gimbal assembly.

9. The computer-implemented method of claims 7 or 8, wherein the first, second and third motors each comprise at least one from the group of: a gimbal motor; a brushless motor; a brushless gimbal motor; a gimbal drive motor; and/or any suitable motor for use in adjusting and/or maintaining the pointing direction and/or alignment of the first section of payload in the direction of the AUT.

10. The computer-implemented method of any of claims 7 to 9, wherein the first, second and third motors corresponding to a yaw motor, pitch motor and roll motor, respectively.

11. The computer-implemented method of any of claims 7 to 10, wherein controlling the gimbal assembly further comprising:

calculating the theoretical angles for yaw, pitch and roll of the payload in relation to the AUT;

calculating drift offsets of the gimbal assembly based on comparing feedback from data representative of current received position of the aircraft and with attitude and heading reference system of the aircraft for correcting drift in the gimbal assembly; and

sending angle commands and drift offsets to a gimbal controller for controlling one or more of the first motor, second motor, and third motors based on combining drift offsets with theoretical angles for yaw, pitch and roll.

12. The computer-implemented method of any of claims 7 to 11 , wherein controlling the gimbal assembly further comprising:

when using the payload for testing linear polarized systems, controlling the gimbal assembly to maintain polarisation alignment of the payload communication sensor interface polarisation with the AUT polarisation by:

comparing the received in-flight position of the aircraft with the received position of the AUT;

calculating a theoretical roll adjustment value for at least adjusting the roll angle of the payload in relation to the AUT based on the comparison for maintaining polarisation alignment; and

sending a roll angle command to the roll motor of gimbal assembly.

13. The computer-implemented method as claimed in any preceding claim, wherein a base station is located at a geographic position relative to the AUT, the location of the base station defining a reference position for the aircraft during testing of the AUT, and receiving the position of the AUT further comprising:

receiving the position of the base station;

calculating the position of the AUT based on the geographic position of the AUT relative to the position of the base station.

14. The computer-implemented method as claimed in any preceding claim, wherein the payload further comprises a camera located at the first end of the payload, and receiving the position of the AUT further comprising:

analysing one or more image(s) from the camera to identify a position of the AUT; and

calculating the position of the AUT based on the identified position of the AUT in said one or more analysed images.

15. The computer-implemented method as claimed in claim 14, wherein:

analysing one or more image(s) from the camera to identify a position of the AUT further comprises analysing one or more image(s) from the camera to identify the AUT ; and calculating the position of the AUT based on the position of the identified AUT in said one or more analysed images.

16. The computer-implemented method as claimed in claim 14 when dependent from claim 13, wherein:

analysing one or more image(s) from the camera to identify a position of the AUT further comprises analysing one or more image(s) from the camera to identify the base station; and

calculating the position of the AUT based on the position of the identified base station in said one or more analysed images and based on the geographic position of the AUT relative to the position of the identified base station.

17. The computer-implemented method as claimed in any preceding claim, wherein the AUT includes a beacon signal and receiving the position of the AUT further comprising:
receiving the beacon signal associated with the AUT; and
determining the position of the AUT based on the received beacon signal.

18. The computer-implemented method as claimed in any of claims 14 to 17 when dependent from claim 13, wherein the base station includes a beacon signal and receiving the position of the AUT further comprising:

receiving the beacon signal associated with the based station; and

determining the position of the AUT based on the received beacon signal from the base station and the geographic position of the AUT relative to the position of the base station.

19. The computer-implemented method as claimed in any preceding claim, further comprising maintaining pointing of the first section of the payload towards a designated position in relation to the AUT.

~~20. The computer-implemented method as claimed in any preceding claim, wherein the communication sensor interface is a transceiver and the method further comprising controlling the transceiver of the payload to perform at least one or more from the group of:~~

~~generate and transmit a continuous wave or modulated test signal in a desired frequency;~~

~~receive a continuous wave or modulated test signal in a desired frequency;~~

~~generate and transmit a linearly polarised signal to the AUT;~~

~~generate and transmit a circularly polarised signal to the AUT;~~

~~receive a linearly polarised signal from the AUT; and~~

~~receive a circularly polarised signal from the AUT.~~

~~21. The computer-implemented method as claimed in any preceding claim, wherein the communication sensor interface is a transceiver, the method further comprising controlling the gimbal assembly to perform at least one or more from the group of:~~

~~pointing an RF transmitting feed horn of the transceiver at a specified geometric point associated with the AUT;~~

~~cancelling any movements or motion of the aircraft to maintain pointing of the RF transmitting feed horn at the specified geometric point or the AUT ;~~

~~maintaining alignment of the RF transceiver feedhorn polarization with the corresponding AUT transceiver feedhorn polarisation during testing of the AUT.~~

~~22. The computer-implemented method as claimed in any preceding claim, wherein, when testing the AUT, the method further comprising:~~

~~maintaining pointing and/or alignment of the first section of the payload towards the AUT during a flight test route of the aircraft in relation to the AUT;~~

~~receiving at the communication sensor interface measurements associated with at least the main beam of the AUT ; and~~

~~collecting measurement data points associated with at least the main beam azimuth and elevation of the AUT ;~~

~~sending the collected measurement data points and position of aircraft to a control station for use in determining at least the AUT pointing based on analysing the collected measurement data points.~~

~~23~~20. A gimbal stabilisation system for an aircraft comprising a control assembly rotatably coupled to a gimbal assembly comprising a payload, the control assembly comprising a controller configured to operate the gimbal assembly to maintain pointing of a first section of the payload towards an antenna under test, AUT, with a second section of the payload rotatably coupled to the gimbal assembly, wherein the first section comprises a communication sensor interface for use in testing the AUT.

~~24~~21. The gimbal stabilisation system as claimed in claim ~~23~~20, the gimbal assembly further comprising operating the controller of the gimbal stabilisation system based on the computer-implemented method according to any of claims 1 to ~~22~~19.

~~25~~22. An apparatus comprising a processor unit, a memory unit, and a communication interface, the processor unit connected to the memory unit and the communication interface, wherein the processor unit, memory unit and communication interface are adapted to implement the computer-implemented method as claimed in any of claims 1 to ~~22~~19.

~~26~~23. A system comprising:

an aircraft comprising an gimbal stabilisation apparatus according to claim ~~25~~22; and an antenna under test,

wherein the aircraft is configured to perform testing of the AUT using the gimbal stabilisation apparatus.

~~27~~24. A system according to claim ~~26~~23, an apparatus according to claim ~~25~~22, a gimbal stabilisation system according to claims ~~23~~20 or ~~24~~21, or a computer-implemented method according to any of claims 1 to ~~22~~19, wherein the aircraft is an unmanned aerial vehicle.

~~28~~25. A computer-readable medium comprising computer code or instructions stored thereon, which when executed on a processor, causes the processor to perform the computer implemented method according to any of claims 1 to ~~22~~19.

~~29. A system as herein described with reference to the accompanying drawings.~~

~~30. A method as herein described with reference to the accompanying drawings.~~

~~31. An apparatus as herein described with reference to the accompanying drawings.~~

~~32. A computer program product as herein described with reference to the accompanying drawings.~~