A control system (10) for controlling a non-ground engaging vehicle includes a human machine interface (HMI) (12) configured to replicate a control interface of a motor vehicle. The HMI (12) includes a steering device (14) for controlling positional changes of the vehicle; a mode selector (20) for selecting a desired operational mode of the vehicle; and a pedal assembly (26) for increasing or retarding progress of the vehicle through the medium in which the vehicle is travelling. The system (10) further includes a control processor (32) in communication with the HMI (12), the control processor (32) being configured to receive command signals output from the HMI (12), the control processor (32) processing the command signals and producing output signals to control vehicle control elements of the vehicle.
The present application claims priority from Australian Provisional Patent Application No 2014903824 filed on 25 September 2014, the contents of which are incorporated herein by reference.

This disclosure relates, generally, to the control of vehicles and, more particularly, to a control system for controlling a non-ground engaging vehicle, to a vehicle operating system including the control system and to a method of operating a non-ground engaging vehicle. The disclosure further relates to a human-machine interface for a non-ground engaging vehicle and to a non-ground engaging vehicle simulator.

Still further, this disclosure relates to a control system for controlling a non-fixed wing aircraft and to a method of controlling a non-ground-engaging vehicle.

Controlling certain vehicles can be very complex due to the counter-intuitive nature of the inputs required. This also requires high levels of concentration by the operator which, effectively, limits usage time to minimise the likelihood of fatigue adversely affecting the operator.

To train an operator to operate such vehicles involves many hours and there is a large drop-out rate resulting in adverse economic consequences.

Any discussion of documents, acts, materials, devices, articles or the like which has been included in the present specification is not to be taken as an admission that any or all of these matters form part of the prior art base or were common general knowledge in the field relevant to the present disclosure as it existed before the priority date of each claim of this application.
Summary

[0007] Throughout this specification the word "comprising", or variations such as "comprises" or "comprising", will be understood to imply the inclusion of a stated element, integer or step, or group of elements, integers or steps, but not the exclusion of any other element, integer or step, or group of elements, integers or steps.

[0008] In a first aspect, there is provided a control system for controlling a non-ground engaging vehicle, the control system including

- a human machine interface (HMI) configured to replicate a control interface of a motor vehicle, the HMI including
  - a steering device for controlling positional changes of the vehicle;
  - a mode selector for selecting a desired operational mode of the vehicle; and
  - a pedal assembly for increasing or retarding progress of the vehicle through the medium in which it is travelling; and
- a control processor in communication with the HMI, the control processor being configured to receive command signals output from the HMI, the control processor processing the command signals and producing output signals to control vehicle control elements of the vehicle.

[0009] In this specification, the term "vehicle" is to be understood, unless the context clearly indicates otherwise, to include any non-ground engaging contrivance by means of which someone travels or something is conveyed and includes aircraft, waterborne craft and hovercraft.

[0010] While the control system has been developed particularly for use in controlling non-fixed wing aircraft, those skilled in the art will appreciate that the control system could equally well be used in controlling hovercrafts, other aircraft and waterborne craft, in particular, submersible waterborne craft. The term "non-ground engaging vehicle" is therefore intended to encompass, unless the context clearly indicates otherwise, any aircraft, waterborne craft or hovercraft.

[0011] The steering device may be a steering wheel, the steering wheel being configured to control altitude changes and directional changes of the vehicle.
The mode selector may include an interlock for inhibiting inadvertently changing a selected operational mode of the vehicle.

The pedal assembly may be a foot-operated pedal assembly comprising at least an accelerator pedal for altering a speed of the vehicle and a brake pedal for retarding the speed of the vehicle. It will be appreciated that, for disabled people, such as paraplegics, the pedal assembly may comprise hand-operated paddles or other hand-operated devices and the term "pedal assembly" is intended to encompass such devices as well.

The steering device, the mode selector and the pedal assembly may each have positional sensors associated with them, the positional sensors communicating with the control processor to provide the control processor with the command signals.

The control processor may be configured to cause a directional change of the vehicle upon receipt of a suitable command signal from the steering device unless a condition precedent is met in which case, instead of a directional change occurring, the control processor causes the vehicle control elements to impart yaw to the vehicle. In other words, the control processor is configured to minimise yaw effects arising due to change in inputs via the steering device unless the condition precedent is met.

The predetermined condition may comprise a travelling speed below a predetermined threshold and simultaneous operation of the pedal assembly. More particularly, the travelling speed is the speed of the vehicle relative to a substrate, such as the ground, and the predetermined threshold is selected to be less than about 10 knots and, more particularly, less than, or equal to, about 5 knots but greater than zero.

In a second aspect, there is provided a non-ground engaging vehicle operating system which includes

a control system, as described above; and

a plurality of vehicle control elements operatively connected to the control processor of the control system.

In an embodiment, the operating system may include a communications bus via which the control processor communicates with the vehicle control elements.
Each vehicle control element may include an actuator for effecting actuation of that vehicle control element, the operating system including a data processor module interposed between the communications bus and the actuators of the vehicle control elements. The operating system may include a display module for displaying data related to operating parameters of the vehicle, the display module being in communication with the data processing module.

The operating system may include a navigational sensor pack connected to the communications bus for providing navigational information to the control processor, the navigational sensor pack including at least positional sensors, locational sensors, heading sensors and speed determining sensors.

The operating system may include a state sensor module, in communication with the communications bus and each of the vehicle control elements, for providing information regarding the state of each of the vehicle control elements to the control processor.

The operating system may include a weight sensing module in communication with the control processor via the communications bus for determining the presence or absence of weight on a support structure of the vehicle.

In another embodiment, the control system may be arranged remotely of the vehicle, the control system effecting control of the vehicle by communicating wirelessly with the vehicle.

The vehicle may be a non-fixed wing aircraft. The non-fixed wing aircraft may be a helicopter.

In a third aspect, there is provided a control system for controlling a non-fixed wing aircraft, the control system including

- a human machine interface (HMI) configured to replicate a control interface of a motor vehicle, the HMI including
  - a steering device for controlling positional changes of the aircraft;
  - a mode selector for selecting a desired operational mode of the aircraft; and
  - a pedal assembly for increasing or retarding progress of the aircraft through the
air; and

a control processor in communication with the HMI, the control processor being configured to receive command signals output from the HMI, the control processor processing the command signals and producing output signals to control flight control elements of the aircraft.

[0026] In a fourth aspect, there is provided a non-fixed wing aircraft human machine interface (HMI) which includes

an aircraft steering device for controlling positional changes of the aircraft;
a mode selector for selecting a desired operational mode of the aircraft; and
a pedal assembly for increasing or retarding progress of the aircraft through the air, in use.

[0027] In a fifth aspect, there is provided a non-ground engaging vehicle simulator which includes

a human machine interface (HMI) configured to replicate a control interface of a motor vehicle, the HMI including

a steering device for controlling a simulation of positional changes of the vehicle;
a mode selector for selecting a desired, simulated operational mode of the vehicle; and
a pedal assembly for simulating increasing or retarding progress of the vehicle through the medium in which the vehicle is simulated to be travelling; and

a control processor in communication with the HMI, the control processor being configured to receive command signals output from the HMI, the control processor processing the command signals and producing output signals to control simulated vehicle control elements.

[0028] In a sixth aspect, there is provided a method of controlling a non-ground-engaging vehicle, the method including

operating a mode selector of the vehicle for selecting a desired operational mode of the vehicle;
using a steering device to effect positional changes of the vehicle; and
using a pedal assembly of the vehicle for increasing or retarding progress of the vehicle through the medium in which it is travelling.

[0029] The method may include operating the mode selector to determine a direction of movement of the vehicle and a mode of movement. By "mode of movement" is meant a rate of displacement, if any, in the selected direction of movement. In the case where the vehicle is a helicopter, the "mode of movement" may include a hover mode, the hover mode further encompassing a "hover forward" or a "hover rearward" mode.

[0030] The method may include linearly displacing the steering device to effect change of position relative to a surface spaced from the vehicle and rotationally displacing the steering device to effect directional change from a previous heading of the vehicle.

[0031] The pedal assembly may comprise at least an accelerator pedal and a brake pedal, the method including operating the accelerator pedal to increase or decrease the speed of the vehicle and operating the brake pedal to retard motion of the vehicle.

[0032] The method may include causing a directional change of the vehicle upon receipt of a suitable command signal from the steering device unless a condition precedent is met in which case, instead of causing a directional change of the vehicle, causing yaw to be imparted to the vehicle.

Brief Description of Drawings

[0033] Embodiments of the disclosure are now described by way of example with reference to the accompanying diagrammatic drawings in which:

[0034] Fig. 1 shows a schematic block diagram of an embodiment of a control system for controlling a non-ground engaging vehicle;

[0035] Fig. 2 shows a block diagram of an embodiment of a non-ground engaging vehicle operating system;

[0036] Fig. 3 shows a mode selector transition diagram for a mode selector of the control system of Fig. 1:
Fig. 4 shows a flow chart of an embodiment of an initialisation and mode selection process using the control system of Fig. 1;

Fig. 5 shows a flow chart of a "Park" mode of operation selected via the mode selector of the control system of Fig. 1;

Fig. 6 shows a flow chart of a "Forward" mode of operation selected via the mode selector of the control system of Fig. 1;

Figs. 7a & 7b show a flow chart of a "Hover forward" mode of operation selected via the mode selector of the control system of Fig. 1;

Figs. 8a & 8b show a flow chart of a "Hover rearward" mode of operation selected via the mode selector of the control system of Fig. 1;

Fig. 9 shows a schematic block diagram of another embodiment of a control system for controlling a remotely controlled vehicle; and

Fig. 10 shows a schematic block diagram of a non-ground engaging vehicle simulator.

**Detailed Description of Exemplary Embodiments**

In Fig. 1 of the drawings reference numeral 10 generally designates an embodiment of a control system for controlling a non-ground engaging vehicle (as defined). The control system 10 has been developed particularly for use in controlling operation of a non-fixed wing aircraft, specifically, a helicopter.

For ease of explanation, the disclosure will be described with reference to its application to a helicopter. However, those skilled in the art will readily appreciate that the control system 10 can be used, without modification or with extremely minimal modification, in controlling any other suitable non-ground engaging vehicle, particularly those having a yaw capability. Another particular application of the control system 10 would be in controlling the operation of waterborne vehicles, more particularly, submersible waterborne
vehicles such as submarines. The control system 10 could also be used in controlling a hovercraft.

[0046] The control system 10 includes a human machine interface (HMI) 12 configured to replicate a control interface of a motor vehicle. The HMI 12 includes a steering device 14 for controlling positional changes of the helicopter. In the illustrated embodiment, the steering device 14 comprises a steering wheel 16 mounted on a steering column 18.

[0047] The HMI 12 further includes a mode selector 20 for selecting a desired operational mode of the helicopter. In the illustrated embodiment, the mode selector 20 comprises a selector lever 22 operable by an operator of the helicopter to select the desired operational mode. The selector lever 22 is mounted on a selector mechanism 24 responsive to the position of the selected lever 22 relative to the selector mechanism 24.

[0048] In other embodiments, the mode selector 20 could be implemented or configured as a keypad with button selectors, a touch sensitive display, or the like.

[0049] Still further, the HMI 12 includes a pedal assembly 26 for increasing or retarding progress of the helicopter through the air. The pedal assembly 26 includes a speed altering pedal, conveniently referred to as an accelerator pedal 28, and a progress retarding pedal, conveniently referred to as a brake pedal 30. Generally, the pedal assembly 26 would be operated by feet of the operator. However, in other embodiments, the pedal assembly 26 could be implemented in the form of hand operated paddles, or the like, mounted, for example, on the steering column 18 of the steering device 14.

[0050] The control system 10 includes a control processor 32 which communicates with the HMI 12. In particular, the control processor 32 receives command signals output from the HMI 12. The control processor 32 processes the command signals to produce output signals to control vehicle control elements, in the form of flight control mechanisms 34 (Fig. 2) in the described embodiment. The command signals output by the HMI 12 are generated by sensors associated with each of the components 14, 20 and 26.

[0051] In the case of the steering device 14, the steering device 14 is used to control climb and descent as well as direction of the helicopter. To cause the helicopter to climb or
descend, the steering wheel 16 of the steering device 14 is displaced linearly with respect to the steering column 18. The steering device 14 thus includes a linear position sensor 36 associated with the steering column 18.

[0052] To cause the helicopter to climb, the steering wheel 16 is pulled outwardly in the direction of arrow 38 relative to the steering column 18. The sensor 36 is a variable-potentiometer type of sensor and the extent to which the steering wheel 16 is displaced relative to the steering column 18 will govern the rate of climb of the helicopter.

[0053] Conversely, to cause the helicopter to descend, the steering wheel 16 is pushed inwardly in the direction of arrow 40 relative to the steering column 18. Once again, because of the configuration of the sensor 36, the extent to which the steering wheel 16 is displaced relative to the steering column 18 will govern the rate of descent of the helicopter.

[0054] The steering wheel 16 may have a null position on the steering column 18 at which position the helicopter neither climbs nor descends. In an embodiment, the steering wheel 16 is biased or defaults to this null position.

[0055] While the embodiment described refers to changing altitude via a linear displacement of the steering wheel 16 relative to the steering column 18, in another embodiment, the same effect can be achieved by raising or lowering the steering wheel 16 relative to a datum position.

[0056] To effect a directional change from a heading of the helicopter, i.e. to effect a balanced turn to the left or right, the steering wheel 16 is rotated in the same way as a steering wheel of a motor vehicle. Thus, the steering device 14 includes a rotary position sensor 42 for detecting the rotary position of the steering wheel 16 relative to the steering column 18.

[0057] Hence, to effect a balanced left turn of the helicopter, the steering wheel 16 is rotated in the direction of arrow 44 which causes the helicopter to translate to the left unless a condition precedent is met, as will be described in greater detail below. Conversely, to effect a balanced right turn of the helicopter, the steering wheel 16 is rotated in the direction of arrow 46 which causes the helicopter to translate to the right unless the condition precedent is met.
[0058] The sensor 42 is also a variable potentiometer type of sensor and the extent to which
the steering wheel 16 is rotated in the relevant direction will govern the sharpness of turn in
that direction.

[0059] Once again, the steering wheel 16 may have a rotational null position at which
position the helicopter maintains its heading and translates neither to the left nor to the right.
The steering wheel 16 is biased or defaults to this null position.

[0060] Signals output from the sensors 36 and 42 are fed via a communications link 48 to
the control processor 32. As illustrated, the communications link 48 is shown as a wired link
but it will be appreciated that the sensors 36 and 42 could communicate wirelessly with the
control processor 32.

[0061] The selector lever 22 is displaceable relative to the selector mechanism 24 bi-
directionally in the direction of arrows 50. The selector lever 22 can adopt one of four
positions being, firstly, a "Park" position 52, secondly, a "Forward" position 54, thirdly, a
"Hover forward" position 56 and, fourthly, a "Hover rearward" position 58. These positions
will be discussed in greater detail below with reference to Figs. 3-8 of the drawings.

[0062] Once again, the selected position of the selector mechanism 24 is communicated to
the control processor 32 via a communications link 60. As before, while the communications
link 60 is shown as a wired connection, the communications link 60 could be a wireless
connection.

[0063] The accelerator pedal 28 of the pedal assembly 26 has a force/position sensor 62
associated with it. Similarly, the brake pedal 30 has a force/position sensor 64 associated
with it.

[0064] To increase the speed of the helicopter, the accelerator pedal 28 is operated or
depressed in the direction of arrow 66. The rate at which the speed increases depends on the
rate at which the pedal 28 is depressed. When the position of the accelerator pedal 28 is
stationary or static, the helicopter will maintain a constant speed. If the operator takes his or
her foot off the accelerator pedal 28, the pedal 28 is biased to return to a null position in the
direction of arrow 68. As the accelerator pedal 28 moves to the null position, the speed of the helicopter will decrease.

[0065] Depending on the operating mode of the helicopter, variation in speed of the helicopter is measured either with respect to the air mass through which the helicopter is moving or with respect to the ground. Thus, in the case of normal forward flight, speed is measured with respect to the air mass whereas, in the case of the Hover forward mode or Hover rearward mode, speed is measured with respect to a substrate, such as the ground, over which the helicopter is flying.

[0066] Operation of the brake pedal 30 by the operator causes progress of the helicopter relative to the air mass and/or the substrate being traversed to be retarded. The higher the pressure placed on the pedal 30, the greater the retardation will be. The control processor 32 is operable to determine the lowest safe operating speed to which the helicopter can be brought when the brake pedal 30 is depressed. In some circumstances the lowest safe operating speed may be greater than zero while, in other circumstances, a zero air speed may be selected by the control processor 32.

[0067] The brake pedal 30 is biased to a "zero retardation" position. To overcome the bias, a pilot is required to exert a force in a direction of arrow 69.

[0068] The brake pedal 30 is also used to give effect to the condition precedent as will be described in greater detail below.

[0069] As in the case of the previous components, outputs from the sensors 62 and 64 are sent via a communications link 70 to the control processor 32. The communications link 70, while shown as a wired link, could, once again, instead be a wireless link.

[0070] As shown in greater detail in Fig. 2 of the drawings, signals from the sensors 36 and 42 of the steering device 14 are processed by a signal processor 72 to generate the command signals output on the communications link 48. The signal processor 72 generates a command signal representative of operator or pilot input.

[0071] Similarly, the position of the selector lever 22 of the mode selector 20 is detected by a sensor 74 which outputs a signal to a signal processor 76. The signal processor 76 generates
a signal representative of the selected mode which is fed via the communications link 60 to
the control processor 32.

[0072] Signals from the sensors 62 and 64 of the pedal assembly 22 are processed by a
signal processor 78 to generate the command signals output on the communications link 70,
these command signals, once again, being representative of pilot input.

[0073] In Fig. 2 of the drawings, reference numeral 80 generally designates an embodiment
of a vehicle operating system in the form of a helicopter operating system. The operating
system 80 includes the control system 10. An output from the control processor 32 of the
control system 10 is fed to a communications bus 82. Various other components of the
operating system 80 are connected to the communications bus 82 as described below.

[0074] In particular, signals output from the control processor 32 are fed from the
communications bus 82 to a data processing module, or data processor, 84. The output
signals from the control processor 32 are processed by the data processor 84 prior to being fed
to flight control mechanism actuators, indicated schematically at 86 in Fig. 2 of the drawings.
The actuators 86 control operation of the various flight control mechanisms 34.

[0075] These flight control mechanisms 34 are, for example, servos for controlling various
components of the helicopter. In particular, the servos control the position of flight surfaces
of aerodynamic components of the helicopter. Thus, for example, the servos control pitch of
the blades of a main rotor and a tail rotor of the helicopter, etc.

[0076] The operating system 80 includes a state sensor module 88 which communicates
with the actuators 86 via a link 90 to feed data regarding the state (i.e. the position of each
flight control mechanism 34) back to the control processor 32.

[0077] A navigational sensor pack 92 forms part of the operating system 80. The
navigational sensor pack 92 provides navigational information and status to the control
processor 32 via the communications bus 82.

[0078] The navigational sensor pack 92 includes positional sensors, locational sensors,
heading sensors and speed determining sensors for determining altitude, location, heading and
speed. To determine position and location, the sensors include gyroscopes, GPS units,
accelerometers, altimeters, laser height measuring units, or the like. The speed determining sensors include Pitot tubes, etc. The heading sensors include the GPS units, a compass, or the like.

[0079] The operating system 80 further includes a weight sensing module 94 in communication with the control processor 32 via the communications bus 82. The weight sensing module 94 is a "weight on wheels" sensor for determining whether or not the helicopter is airborne.

[0080] The data output by the control processor 32 is displayed on a display module 96 of the helicopter, the data being fed to the display module 96 via the communications bus 82 and the data processor 84.

[0081] Referring now to Fig. 3 of the drawings, a mode selection transition diagram is illustrated and is designated by reference numeral 100. This transition diagram 100 illustrates mode selection using the mode selector 20 of the control system 10 and shows the four selectable modes 52, 54, 56 and 58.

[0082] When a flight is to be initiated, the pilot initiates a start sequence as illustrated at 102. Initialisation of the helicopter, as shown at 104, involves conducting a self-test as shown at 106. These self-tests are conventional routines carried out by the operating system 80 of the helicopter to ensure that all systems are functional. The selector lever 22 of the mode selector 20 is in the Park position.

[0083] As a safety measure, the pilot is not able to switch directly from one mode to another mode without first selecting an intermediate position labelled as "Mode select" 108 in Fig. 3 of the drawings. Thus, for example, the pilot is not able to go directly from the Park position 52 to the Forward position 54 without first selecting the Mode select position 108. Similarly, when the selector lever 22 is in the Forward position 54, the pilot is not able to select any of the other positions 52, 56 or 58 without first selecting the Mode selector position 108. The same applies when the selector lever 22 is in either of the other positions 56 or 58.

[0084] As also shown in Fig. 3 of the drawings, the mode selector 20 has interlocks 110 associated with it. The interlocks 110 are used as part of a pre-shutdown procedure prior to
shutting down the helicopter and stopping it as shown at 112. These interlocks 110 are also
used as a safety feature which prevents operation of the helicopter, for example, when
detectors (not shown) detect persons approaching the helicopter or when others safety issues
arise.

[0085] Referring now to Fig. 4 of the drawings a flow chart of initialisation procedures and
mode selection is illustrated and is designated generally by the reference numeral 114. Thus,
following an initial start step 102, power is turned on as shown at 116. After power turn on,
the initialisation and self-test routines 104 are performed.

[0086] Following conclusion of the self-test 104, the control processor 32 queries whether
the built-in test (BIT) has passed as shown at 118. If the test has been unsuccessful, an error
reporting routine 120 is initiated, the interlocks operated as shown at 122 and the helicopter is
powered down as shown at 124.

[0087] Conversely, if the BIT is successful, the control processor 32 detects that the selector
lever 22 of the mode selector 20 is in the Park mode 52 as shown at 126. The control
processor 32 then detects whether or not the pilot wishes to change mode as shown at 128 and
determines whether or not it is safe to do so as shown at 130.

[0088] If it is safe to do so, the control processor 32 detects which mode has been selected
as shown at 132, 134 or 136. If it is not safe to do so, the control processor 32 keeps the
selector lever 22 in the Park position 52.

[0089] When one of the other modes 54, 56 or 58 is selected, the control processor 32
continuously monitors that the relevant mode is being maintained as shown at 138, 140, 142,
as the case may be, during operation of the helicopter. Further, in respect of each mode, the
control processor 32 monitors when a change mode request is received from the pilot as
shown at 144, 146 or 148, depending on which mode is currently active. In each case, the
control processor 32 determines whether or not a change of mode is permitted as shown at
150, 152 or 154.
At the end of a flight, the control processor 32 monitors whether or not the helicopter is to be shut down as shown at 156. If the query is answered in the affirmative, the interlocks and power down procedures of step 122 are carried out.

In Fig. 5 of the drawings, reference numeral 158 generally designates a flow chart illustrating the Park mode 52. When in the Park mode 52, and following powering up of the helicopter, the control processor 32 carries out a Park mode functions procedure as shown at 160. This procedure involves operating interlocks (not shown) of the helicopter to prevent starting of the rotors in unsafe situations, for example, when people are in the vicinity of the helicopter.

Further, when the weight on wheels sensors 94 of the operating system 80 determine that the helicopter is on the ground, while in Park mode the helicopter can be taxied and this falls within the functions 160. This applies only in the case of a steerable helicopter having wheel brakes.

As previously described, the control processor 32 determines when a mode change request is received as shown at 128 and determines whether or not to allow the mode change as shown at 130. If it is safe to do so, the control processor 32 allows change of mode as shown at 162.

In Fig. 6 of the drawings, reference numeral 164 generally designates a flow chart of the Forward mode of operation 54. This mode of operation is selected for forward flight of the helicopter.

In this mode, and while the helicopter is in flight, the control processor 32 determines whether or not the pilot wishes to change from a particular heading by detecting angular motion of the steering wheel 16 of the steering device 14 as shown at 166. Assuming a change in heading is to be effected, the control processor 32 determines whether a turn to the left or to the right is required as shown at 168. The control processor 32 issues the appropriate commands to the flight control mechanisms 34 to effect a right turn 170 or a left turn 172 as the case may be.
[0096] The control processor 32 then checks to see whether or not the steering wheel 16 has returned to its zero or null position as shown at 174 or 176, as the case may be. If the steering wheel 16 has returned to its null position, the control processor 32 causes the helicopter to continue on the new heading. If not, the control processor 32 causes the helicopter to continue to effect the turn on to the proposed new heading.

[0097] The control processor 32 also continuously monitors for any commands relating to a change of altitude by monitoring for linear position change of the steering wheel 16 relative to the steering column 18 as shown at step 178. When the control processor 32 detects a command to change altitude, the control processor 32 determines whether or not it is a command to climb or to descend by checking whether or not the steering wheel 16 has been moved in the direction of arrow 40 as shown at 180 in Fig. 6. If the control processor 32 determines that this is the case, it issues a descend command as shown at 182.

[0098] Conversely, if the control processor 32 determines that the steering wheel 16 has been moved in the direction of arrow 38 relative to the steering column 18, the control processor 32 issues a climb or ascend command as shown at 184. In either case, the control processor 32 monitors when the steering wheel has been returned to its zero or null position as shown at 186 or 188, as the case may be. Once the steering wheel 16 has been returned to its null position, the control processor 32 causes the helicopter to level out and to continue at the new altitude.

[0099] As shown at 190, the control processor 32 also continuously monitors for receipt of any commands relating to change of speed of the helicopter. When the pilot wishes to increase the speed of the helicopter, the pilot does so by pressing the accelerator pedal 28 of the pedal assembly 26. The sensor 62 associated with the accelerator pedal 28 sends a signal to the control processor 32. The control processor 32 determines whether or not the received signal represents an increase in pedal pressure on the accelerator pedal 28. If so, the control processor 32 issues an increase in speed command as shown at 194. Conversely, if there is no increase in pedal pressure but, instead, a lessening of pressure on the accelerator pedal 28, the control processor 32 issues a decrease in speed command as shown at 196.

[0100] The control processor 32 monitors a feed from the sensor 62 to determine when the pedal pressure on the accelerator pedal 28 is static as shown at 198 and 200, as the case may
be. When this occurs, the control processor 32 causes the helicopter to proceed at the speed associated with that static position of the accelerator pedal 28.

[0101] The control processor 32 also monitors incoming command signals from the sensor 64 associated with the brake pedal 30 to detect whether or not pressure has been increased on the brake pedal 30 as shown at 202. When the control processor 32 detects a command signal relating to an increase in pressure on the brake pedal 30, the control processor 32 issues a decrease in air speed command as shown at 204.

[0102] The control processor 32 monitors to ascertain when the brake pedal 30 returns to its zero position, i.e. the removal of pressure on the brake pedal 30, as shown at 206. When the control processor 32 detects that pressure has been removed from the brake pedal 30, it proceeds as though no command to decrease air speed was received.

[0103] In Figs. 7a & 7b, reference numeral 210 generally designates a flow chart representing the actions associated with the Hover forward mode 56. In this mode, the condition precedent referenced above with reference to the steering wheel 16 input is applicable.

[0104] In this mode, while the control processor 32 monitors the angular position of the steering wheel 16 relative to the steering column 18, as shown at 212, and the direction in which the steering wheel 16 is rotated relative to the steering column 18, as shown at 214, the control processor 32 also monitors whether or not the condition precedent is present.

[0105] The first condition for which the control processor 32 monitors is pressure applied to the brake pedal as shown at 216 and 218, depending on the direction in which the steering wheel 16 has been rotated. The second condition for which the control processor 32 monitors is the ground speed of the helicopter, as shown at 220 and 222, once again, depending on the direction in which the steering wheel 16 has been rotated.

[0106] In particular, the control processor 32 monitors whether or not the ground speed is above 0 knots but less than an upper ground speed threshold. For example, the upper threshold may be a ground speed of less than 10 knots and, more particularly, less than, or equal to, about 5 knots. If both of these conditions are satisfied then, when the steering wheel
16 is rotated in a clockwise direction, a yaw to the right command is issued by the control processor 32, as shown at 224. Similarly, if both of these conditions are satisfied then, when the steering wheel 16 is rotated in a counter-clockwise direction, a yaw to the left command is issued by the control processor 32, as shown at 226.

[0107] Conversely, if neither or only one of these conditions is satisfied, the control processor 32 issues a transition to the right command, as shown at 228, or a transition to the left command, as shown at 230, as the case may be, to cause the helicopter to make a transitional change to the right or to the left rather than causing the helicopter to yaw.

[0108] The control processor 32 monitors when the steering wheel 16 returns to its zero or null position, as shown at 232 or 234.

[0109] In the Hover forward mode 56, the control processor 32 monitors linear position changes of the steering wheel 16 relative to the steering column 18 as shown at 236. When a linear position change occurs, the control processor monitors whether or not the linear change position is in the direction of arrow 40 as shown at 238. If this is the case, the control processor 32 issues a descent command as shown at 240 or, conversely, if the direction of linear displacement of the steering wheel 16 relative to the steering column 18 is in the direction of arrow 38, the control processor 32 issues a climb command as shown at 242.

[0110] Thereafter, the control processor 32 monitors when the steering wheel 16 returns to its zero or null position as shown at 244 or 246 and the control processor 32 causes the helicopter to continue at the new altitude.

[0111] As with the Forward mode 54, the control processor 32 also monitors change in position of the accelerator pedal 28, as shown at 248. At step 250, the control processor 32 monitors whether or not there has been an increase in pressure on the accelerator pedal 28. If so, the control processor 32 determines, at 252, whether or not the ground speed of the helicopter is less than, or equal to, a predetermined threshold, for example, 30 knots. If the ground speed is less than, or equal to, the predetermined threshold, the control processor 32 issues an increase ground speed command as shown at 254.
If the control processor 32 determines that the ground speed is at, or over, the predetermined threshold it issues an alert to the pilot to the effect that maximum forward speed in the Hover forward mode has been reached, as shown at 256, and no increase in ground speed will occur.

If there has been a decrease in the pressure applied to the accelerator pedal 28, the control processor 32 issues a decrease ground speed command as shown at 258.

After issuing any increase or decrease in ground speed commands, the control processor 32 continues to monitor the pressure applied to the accelerator pedal 28 and when the control processor 32 determines that this pressure is static, as shown at 260 or 262, the control processor 32 maintains the speed associated with the current position of the accelerator pedal 28.

The control processor 32 also monitors the condition of the brake pedal 30 and whether or not pressure is being applied to the brake pedal 30 as shown at 264. If the control processor 32 detects that pressure has been applied to the brake pedal 30, the control processor 32 issues a decrease air speed command as shown at 266. Once the required lower air speed has been attained, the control processor 32 monitors when the brake pedal 30 returns to its zero or null position, as shown at 268, and the helicopter maintains the new, lower speed.

It is to be noted that, in the case of the brake pedal 30, the control processor 32 also monitors the force applied to the brake pedal 32, the force applied governing the rate at which the air speed is decreased.

In Figs. 8a & 8b of the drawings, reference numeral 270 generally designates a flow chart of the Hover rearward mode 58. As is the case with the Hover forward mode 56, the control processor 32 monitors for a condition precedent when the control processor 32 detects a change in angular position of the steering wheel 16 relative to the steering column 18. This condition precedent is similar to that applicable in the Hover forward mode 56.

Thus, when the control processor 32 detects that there is a change in angular position of the steering wheel 16 as shown at 272 and the direction in which the steering wheel 16 has
been rotated as shown at 274, the control processor 32 then determines whether or not pressure has been applied to the brake pedal as shown at 276 in the case of a clockwise rotation of the steering wheel 16 or as shown at 278 in the case of a counter-clockwise rotation of the steering wheel 16.

[0119] Once again, the second condition for which the control processor 32 monitors is the ground speed of the helicopter as shown at 280 or 282, depending on the direction in which the steering wheel 16 has been rotated.

[0120] As before, the control processor 32 monitors whether or not the ground speed is above 0 knots but less than an upper ground speed threshold. For example, the upper threshold may be a ground speed of less than 10 knots and, more particularly, less than, or equal to, about 5 knots. If both of these conditions are satisfied then, when the steering wheel 16 is rotated in a clockwise direction, a yaw to the right command is issued by the control processor 32 as shown at 284. Similarly, if both of these conditions are satisfied then, when the steering wheel 16 is rotated in a counter-clockwise direction, a yaw to the left command is issued by the control processor 32 as shown at 286.

[0121] Conversely, if neither or only one of these conditions is satisfied, the control processor 32 issues a transition to the right command as shown at 288 or a transition to the left command as shown at 290, as the case may be, to cause the helicopter to make a transitional change to the right or to the left rather than causing the helicopter to yaw.

[0122] In this mode, the control processor 32 also monitors when the steering wheel 16 returns to its zero or null position, as shown at 292 or 294.

[0123] As with the Forward mode 54 as well as the Hover forward mode 56, the control processor 32 monitors linear change of the steering wheel 16 relative to the steering column 18 as shown at 296. When linear change occurs, the control processor 32 monitors whether or not such a change is in the direction of arrow 40. If it is, the control processor 32 issues a descend command as shown at 300. Conversely, if the direction of linear displacement of the steering wheel 16 relative to the steering column 18 is in the direction of arrow 38, the control processor 32 issues a climb command as shown at 302.
[0124] The control processor 32 then monitors when the steering wheel 16 returns to its zero or null position as shown at 304 or 306, as the case may be.

[0125] Once again, in this mode, the control processor 32 monitors for change in pressure applied to the accelerator pedal 28 as shown at 308. The control processor 32 monitors to see if the pressure applied to the accelerator pedal 28 is an increasing pressure as shown at 310. If it is, the control processor 32 determines whether or not the rearward ground speed is less than, or equal to, a predetermined threshold, for example, 15 knots as shown at 312.

[0126] If the ground speed is less than this threshold, the control processor 32 allows the rearward ground speed to increase as shown at 314. If, however, the rearward ground speed is at, or exceeds this threshold, the control processor 32 issues an alert to the pilot that the maximum rearward ground speed has been reached, as shown at 316, and no increase in rearward ground speed occurs.

[0127] If the control processor 32 determines that the pressure applied to the accelerator pedal 28 has been reduced, it issues a decrease in ground speed command as shown at 318. As before, the control processor 32 detects when the pressure on the accelerator pedal 28 becomes static as shown at 320 or 322.

[0128] When the control processor 32 detects that pressure has been applied to the brake pedal 30, as shown at 324, the control processor 32 issues a decrease in air speed command as shown at 326. Following that, the control processor 32 detects when the brake pedal 30 returns to its zero or null position, as shown at 328, and the helicopter maintains the new, lower speed.

[0129] While each of the above flowcharts has been shown as having the wheel change position, change in accelerator pedal position or change in brake pedal position steps following serially, this is for explanation purposes only. In practice, each of the steps relating to wheel change position, change in accelerator pedal position or change in brake pedal position occur independently of each other, i.e. in parallel.

[0130] In the above description, the control processor 32 users bespoke software to effect all controls of the flight control mechanisms 34. In another embodiment, the control processor
32 could be configured to act on existing auto-pilot software. In such an embodiment, any change in inputs to the control processor 32 is regarded as a change to a recorded waypoint in the auto-pilot software. The control processor 32 thus acts on the software to effect positional, heading or speed changes to the helicopter upon the command of the pilot.

[0131] It will also be appreciated that the control processor 32 could include its own auto-pilot software which performs normal auto-pilot operations of the helicopter.

[0132] Referring now to Fig. 9 of the drawings, a further embodiment of the control system 10 is illustrated. With reference to previous drawings, like reference numerals refer to like parts, unless otherwise specified.

[0133] In this embodiment, the control system 10, itself, is the same as the embodiment described above with reference to Fig. 1 of the drawings. Thus, the control system 10 includes the HMI 12 which communicates with the control processor 32.

[0134] However, in this embodiment, the helicopter to be controlled, indicated schematically at 400 in Fig. 9 of the drawings, is a remotely controlled helicopter, or unmanned aerial vehicle (UAV). Thus, the control system 10 includes an antenna 402 which communicates with a corresponding antenna 404 mounted on the helicopter 400. Bi-directional communication occurs between the control system 10 and the helicopter 400 via the antennas 402 and 404 as shown by the bi-directional arrow 406.

[0135] In this way, command signals can be sent via the control system 10 to the helicopter 400 and data from the helicopter 400 are fed back to the control system 10 to enable operation of the helicopter to be monitored and controlled by the control system 10.

[0136] In Fig. 10 of the drawings, reference numeral 410 generally designates an embodiment of a non-ground traversing vehicle simulator. The simulator 410 will be described with reference to its application to a helicopter. However, those skilled in the art will appreciate that the simulator 410 could be configured to simulate any suitable non-ground engaging vehicle.
The simulator 410 includes the control system 10, as described above, comprising the HMI 12 and the control processor 32. However, in this case, the control processor 32 produces output signals to control simulated flight control elements 412 of a helicopter.

The components 14, 20 and 26 of the HMI 12 are haptic components with built-in tactility to impart a real-world feel to a user of the simulator 410.

Due to the HMI 12 of the simulator 410 being exactly the same as the HMI 12 of the helicopter itself, a user can be rapidly trained on the simulator 410.

It is an advantage of the disclosed embodiments that a control system 10 for a helicopter is provided which, the Applicant believes, will significantly reduce the complexity of mastering control of a helicopter. The HMI 12 does away with the need for complex control inputs from the pilot. Thus, the Applicant believes that a pilot will be trained significantly quicker to fly a helicopter and, also, once qualified, will experience less fatigue when operating the controls of the helicopter over an extended period of time.

Further, the provision of the control system 10 will simplify the training regime for a helicopter pilot while at the same time reducing the drop-out rate from training courses. The time taken to train a pilot will also be significantly reduced. The Applicant believes that a trainee will be competent to fly a helicopter within about 3 to 4 hours rather than the approximately 50 hours presently required to achieve competence.

It will be appreciated by persons skilled in the art that numerous variations and/or modifications may be made to the above-described embodiments, without departing from the broad general scope of the present disclosure. The present embodiments are, therefore, to be considered in all respects as illustrative and not restrictive.
CLAIMS:

1. A control system for controlling a non-ground engaging vehicle, the control system including
   a human machine interface (HMI) configured to replicate a control interface of a motor vehicle, the HMI including
   a steering device for controlling positional changes of the vehicle;
   a mode selector for selecting a desired operational mode of the vehicle; and
   a pedal assembly for increasing or retarding progress of the vehicle through the medium in which it is travelling; and
   a control processor in communication with the HMI, the control processor being configured to receive command signals output from the HMI, the control processor processing the command signals and producing output signals to control vehicle control elements of the vehicle.

2. The control system of claim 1 in which the steering device is a steering wheel, the steering wheel being configured to control altitude changes and directional changes of the vehicle.

3. The control system of claim 1 or claim 2 in which the mode selector includes an interlock for inhibiting inadvertently changing a selected operational mode of the vehicle.

4. The control system of any one of the preceding claims in which the pedal assembly is a foot-operated pedal assembly comprising at least an accelerator pedal for altering a speed of the vehicle and a brake pedal for retarding the speed of the vehicle.

5. The control system of any one of the preceding claims in which the steering device, the mode selector and the pedal assembly each have positional sensors associated with them, the positional sensors communicating with the control processor to provide the control processor with the command signals.

6. The control system of any one of the preceding claims in which the control processor is configured to cause a directional change of the vehicle upon receipt of a suitable command signal from the steering device unless a condition precedent is met in which case, instead of a
directional change occurring, the control processor causes the vehicle control elements to impart yaw to the vehicle.

7. The control system of claim 6 in which the predetermined condition comprises a travelling speed below a predetermined threshold and simultaneous operation of the pedal assembly.

8. A non-ground engaging vehicle operating system which includes a control system, as claimed in any one of the preceding claims; and a plurality of vehicle control elements operatively connected to the control processor of the control system.

9. The operating system of claim 8 which includes a communications bus via which the control processor communicates with the vehicle control elements.

10. The operating system of claim 9 in which each vehicle control element includes an actuator for effecting actuation of that vehicle control element, the operating system including a data processor module interposed between the communications bus and the actuators of the vehicle control elements.

11. The operating system of claim 10 which includes a display module for displaying data related to operating parameters of the vehicle, the display module being in communication with the data processing module.

12. The operating system of any one of claims 9 to 11 which includes a navigational sensor pack connected to the communications bus for providing navigational information to the control processor, the navigational sensor pack including at least positional sensors, locational sensors, heading sensors and speed determining sensors.

13. The operating system of any one of claims 9 to 12 which includes a state sensor module, in communication with the communications bus and each of the vehicle control elements, for providing information regarding the state of each of the vehicle control elements to the control processor.
14. The operating system of any one of claims 9 to 13 which includes a weight sensing module in communication with the control processor via the communications bus for determining the presence or absence of weight on a support structure of the vehicle.

15. The operating system of claim 8 in which the control system is arranged remotely of the vehicle, the control system effecting control of the vehicle by communicating wirelessly with the vehicle.

16. The operating system of any one of claims 8 to 15 in which the vehicle is a non-fixed wing aircraft.

17. The operating system of claim 16 in which the non-fixed wing aircraft is a helicopter.

18. A control system for controlling a non-fixed wing aircraft, the control system including
   a human machine interface (HMI) configured to replicate a control interface of a motor vehicle, the HMI including
   a steering device for controlling positional changes of the aircraft;
   a mode selector for selecting a desired operational mode of the aircraft; and
   a pedal assembly for increasing or retarding progress of the aircraft through the air; and
   a control processor in communication with the HMI, the control processor being configured to receive command signals output from the HMI, the control processor processing the command signals and producing output signals to control flight control elements of the aircraft.

19. A non-fixed wing aircraft human machine interface (HMI) which includes
   an aircraft steering device for controlling positional changes of the aircraft;
   a mode selector for selecting a desired operational mode of the aircraft; and
   a pedal assembly for increasing or retarding progress of the aircraft through the air, in use.

20. A non-ground engaging vehicle simulator which includes
   a human machine interface (HMI) configured to replicate a control interface of a
motor vehicle, the HMI including

- a steering device for controlling a simulation of positional changes of the vehicle;
- a mode selector for selecting a desired, simulated operational mode of the vehicle; and
- a pedal assembly for simulating increasing or retarding progress of the vehicle through the medium in which the vehicle is simulated to be travelling; and
- a control processor in communication with the HMI, the control processor being configured to receive command signals output from the HMI, the control processor processing the command signals and producing output signals to control simulated vehicle control elements.

21. A method of controlling a non-ground-engaging vehicle, the method including

- operating a mode selector of the vehicle for selecting a desired operational mode of the vehicle;
- using a steering device to effect positional changes of the vehicle; and
- using a pedal assembly of the vehicle for increasing or retarding progress of the vehicle through the medium in which it is travelling.

22. The method of claim 21 which includes operating the mode selector to determine a direction of movement of the vehicle and a mode of movement.

23. The method of claim 21 or claim 22 which includes linearly displacing the steering device to effect change of position relative to a surface spaced from the vehicle and rotationally displacing the steering device to effect directional change from a previous heading of the vehicle.

24. The method of any one of claims 21 to 23 in which the pedal assembly comprises at least an accelerator pedal and a brake pedal, the method including operating the accelerator pedal to increase or decrease the speed of the vehicle and operating the brake pedal to retard motion of the vehicle.

25. The method of any one of claims 21 to 24 which includes causing a directional change of the vehicle upon receipt of a suitable command signal from the steering device
unless a condition precedent is met in which case, instead of causing a directional change of the vehicle, causing yaw to be imparted to the vehicle.
Fig. 4
INTERNATIONAL SEARCH REPORT

International application No. PCT/AU2015/050570

A. CLASSIFICATION OF SUBJECT MATTER

B64C 27/00 (2006.01)  B64C 13/00 (2006.01)  G05D 1/00 (2006.01)

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

Databases: EPODOC & WIAP - IPC/CPC Marks: B64C27, O05D1, B64C13, B64C37, B64C39, B64C29. Keywords: simplified, easier, control, operate, car like, steering wheel, pedal, accelerate, brake and like terms

Database:TXTE - Keywords: steer, car like, pedal, accelerate, brake, processor, computer, CPU and like terms

Google Patents Search - IPC/CPC Marks: B64C13, B64C27, B64C29, B64C37, B64C39, G05D1, G09B9, B60V1, B63G8, B64C2700, B60F5; Keywords: steering wheel, pedal, foot, feet, mode, lever, simplified, car like, helicopter, rotorcraft, control system, interface, processor, remote, wireless and like terms

Google Search - Keywords: steering wheel, pedals, car like, interface and like terms

C. DOCUMENTS CONSIDERED TO BE RELEVANT

<table>
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<tr>
<th>Category</th>
<th>Citation of document, with indication, where appropriate, of the relevant passages</th>
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<tr>
<td>X</td>
<td>* Further documents are listed in the continuation of Box C</td>
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</table>

See patent family annex

* Special categories of cited documents:
  "A"  document defining the general state of the art which is not considered to be of particular relevance
  "E"  earlier application or patent but published on or after the international filing date
  "L"  document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
  "O"  document referring to an oral disclosure, use, exhibition or other means
  "P"  document published prior to the international filing date but later than the priority date claimed
  "T"  later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
  "X"  document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
  "Y"  document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
  "&"  document member of the same patent family

Date of the actual completion of the international search
26 October 2015

Date of mailing of the international search report
26 October 2015

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Form PCT/ISA/210 (fifth sheet) (July 2009)
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<td>GURSKY, B.I. et al, &quot;Novel Steering Concepts For Personal Aerial Vehicles&quot;, Deutscher luft-und raumfahrtkongress 2013 (German Air and Space Congress 2013), &quot;Synergien zwischen Automotive und Luft- und Raumfahrt&quot; (Synergies between Automotive and Aerospace), 11 September 2013</td>
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<td>X</td>
<td>WO 201 1/40551 A1 (OHIO UNIVERSITY) 10 November 2011 Figures 1-9, Paragraphs 0032, 0058, 0068, 0071, 0072, 0075</td>
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<td>WO 2014/144001 A2 (TERRAFUGIA) 18 September 2014 Figures 1-12, paragraphs 0008, 0009, 0015, 0032, 0037, 0043, 0044</td>
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<td>US 5505407 A (CHIAPPETTA) 09 April 1996 Figures 1-11, Column 9</td>
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<td>Deutscher luft-und raumfahrtkongress 2013 Programm, page 20</td>
<td>1-25</td>
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## Box No. II  Observations where certain claims were found unsearchable (Continuation of item 2 of first sheet)

This international search report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. □ Claims Nos.:
   
   because they relate to subject matter not required to be searched by this Authority, namely:
   
   the subject matter listed in Rule 39 on which, under Article 17(2)(a)(i), an international search is not required to be carried out, including

2. □ Claims Nos.:
   
   because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:

3. □ Claims Nos:
   
   because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a)

## Box No. III  Observations where unity of invention is lacking (Continuation of item 3 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

See Supplemental Box for Details

1. □ As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims.

2. □ As all searchable claims could be searched without effort justifying additional fees, this Authority did not invite payment of additional fees.

3. □ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:

4. □ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

### Remark on Protest

□ The additional search fees were accompanied by the applicant's protest and, where applicable, the payment of a protest fee.

□ The additional search fees were accompanied by the applicant's protest but the applicable protest fee was not paid within the time limit specified in the invitation.

□ No protest accompanied the payment of additional search fees.
Continuation of: Box III

This International Application does not comply with the requirements of unity of invention because it does not relate to one invention or to a group of inventions so linked as to form a single general inventive concept.

This Authority has found that there are different inventions based on the following features that separate the claims into distinct groups:

- Claims 1-18 and 20 are directed to a control system/simulator for a non-ground engaging including a human machine interface configured to replicate a control interface of a motor vehicle, the HMI including a steering device for controlling positional changes of the vehicle, a mode selector for selecting a desired operational mode of the vehicle, a pedal assembly for increasing or retarding progress of the vehicle through the medium in which it is travelling and a control processor in communication with the interface, the control processor processing the command signals and producing output signals to control vehicle control elements of the vehicle. The features of an interface configured to replicate the control interface of a motor vehicle and a control processor are specific to this group of claims.

- Claims 19 and 21-25 are directed to a non-fixed wing aircraft human machine interface/ a method of controlling a non-ground-engaging vehicle including a steering device for controlling positional changes of the vehicle, a mode selector for selecting a desired operational mode of the vehicle and a pedal assembly for increasing or retarding progress of the vehicle. These features (in isolation) are specific to this group of claims.

PCT Rule 13.2, first sentence, states that unity of invention is only fulfilled when there is a technical relationship among the claimed inventions involving one or more of the same or corresponding special technical features. PCT Rule 13.2, second sentence, defines a special technical feature as a feature which makes a contribution over the prior art.

When there is no special technical feature common to all the claimed inventions there is no unity of invention.

In the above groups of claims, the identified features may have the potential to make a contribution over the prior art but are not common to all the claimed inventions and therefore cannot provide the required technical relationship. The only feature common to all of the claimed inventions and which provides a technical relationship among them is a control system/a human machine interface comprising a steering device, a mode selector and a pedal assembly.

However this feature does not make a contribution over the prior art because it is disclosed in:

WO 201 1/14055 1 A1 (OHIO UNIVERSITY) 10 November 201 1

Therefore in the light of this document this common feature cannot be a special technical feature. Therefore there is no special technical feature common to all the claimed inventions and the requirements for unity of invention are consequently not satisfied a posteriori.
This Annex lists known patent family members relating to the patent documents cited in the above-mentioned international search report. The Australian Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

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<td>09 April 1996</td>
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End of Annex

Due to data integration issues this family listing may not include 10 digit Australian applications filed since May 2001.
Form PCT/ISA/210 (Family Annex)(July 2009)