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Declaration under Rule 4.17:

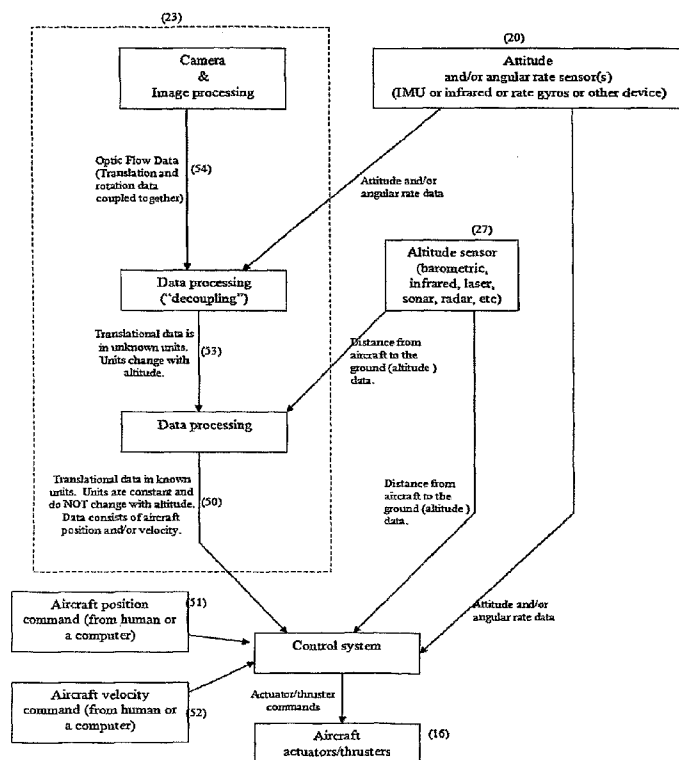
— as to the identity of the inventor (Rule 4.17(i))

Published:

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14 August 2008

(54) Title: SYSTEM FOR POSITION AND VELOCITY SENSE AND CONTROL OF AN AIRCRAFT



(57) Abstract: A system for determining the position and/or velocity of an autonomous aircraft in a low-cost, low-weight manner independent of external technological dependencies such as satellites or beacons is claimed. The solution comprises a combination of traditional technologies (IMUs, altitude sensing, control systems, visual sensing technology, etc.) coupled with algorithms to implement their combined use. The solution is small enough for inclusion on small mass aircraft, yet its precision and capability make it useful for large aircraft as well. Using aircraft position or velocity data, an outer control loop algorithm determines an aircraft target angle and an inner control loop algorithm outputs commands to cause the aircraft to achieve the target angle. Executing these commands, the aircraft can autonomously take-off and land, station hold in a very precise manner, and fly in very close proximity to other objects with little chance of collision.

INTERNATIONAL SEARCH REPORT

International application No.

PCT/US 07/09601

A. CLASSIFICATION OF SUBJECT MATTER IPC(8) - G06F 19/00 (2008.01) USPC - 701/14 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) USPC: 701/14 Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched USPC: 701/3, 4, 7, 14; 702/127, 142, 144; 340/945, 973, 981 Electronic data base consulted during the international search (name of data base and, where practicable, search terms used) PubWest(PGPB,USPT,USOC,EPAB,JPAB); Google Scholar Search Terms Used: VTOL, unmanned, aircraft, video stream, vision sensing, attitude data, rotation, translational, track, object, optic flow data, angular rate data, position, velocity, video, rotational, inertial, dimensions etc.		
C. DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US 2005/0149255 A1 (VOGEL et al.) 07 July 2005 (07.07.2005), para [0035]-[0053]	1-30
Y	US 2004/0167682 A1 (BECK et al.) 26 August 2004 (26.08.2004), para[0034], para[0060]-[0100]	1-27
Y	US 2002/0043949 A1 (CHRISTISON et al.) 18 April 2002 (18.04.2002), para [0025]-[0092]	28-30
A	US 6,484,072 B1 (ANDERSON et al.) 19 November 2002 (19.11.2002)	1-30
A	US 2002/0072832 A1 (BACHINSKI et al.) 13 June 2002 (13.06.2002)	1-30
☐ Further documents are listed in the continuation of Box C. ☐		
* 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 05 March 2008 (05.03.2008)		Date of mailing of the international search report 03 APR 2008
Name and mailing address of the ISA/US Mail Stop PCT, Attn: ISA/US, Commissioner for Patents P.O. Box 1450, Alexandria, Virginia 22313-1450 Facsimile No. 571-273-3201		Authorized officer: Lee W. Young PCT Helpdesk: 571-272-4300 PCT OSP: 571-272-7774

INTERNATIONAL SEARCH REPORT

International application No.

PCT/US 07/09601

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:
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 Extra Sheet

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.:
1-30
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.

INTERNATIONAL SEARCH REPORT

International application No.

PCT/US 07/09601

Continuation of:

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

This application contains the following inventions or groups of inventions which are not so linked as to form a single general inventive concept under PCT Rule 13.1. In order for all inventions to be searched, the appropriate additional search fees must be paid.

Group 1, claims 1-27, drawn to a method of analyzing flight information of an aircraft by analyzing tracking and attitude data.

Group 2, claims 28-30, drawn to a method of determining at least one of a position or velocity of an aircraft using aircraft rotational and movement data.

Group 3, claims 31-40, drawn to a method of providing flight control instructions to an aircraft utilizing control loop algorithms.

Group 4, claims 41-45, drawn to a method of controlling an aircraft by continually calculating flight control data.

Group 5, claims 46-47, drawn to a method for determining flight control data as a function of altitude to achieve smooth flight for the aircraft.

The inventions listed as Groups 1-5 do not relate to a single general inventive concept under PCT Rule 13.1 because, under PCT Rule 13.2, they lack the same or corresponding special technical features for the following reasons: The special technical feature of the Group 1 invention is analyzing flight information of an aircraft by analyzing tracking and attitude data. The special technical feature of the Group 2 invention is determining at least one of a position or velocity of an aircraft using aircraft rotational and movement data. The special technical feature of the Group 3 invention is providing flight control instructions to an aircraft utilizing control loop algorithms. The special technical feature of the Group 4 invention is controlling an aircraft by continually calculating flight control data. The special technical feature of the Group 5 invention is determining flight control data as a function of altitude to achieve smooth flight for the aircraft. None of these special technical features are common to the other groups, nor do they correspond to a special technical feature in the other groups. Therefore, unity of invention is lacking.