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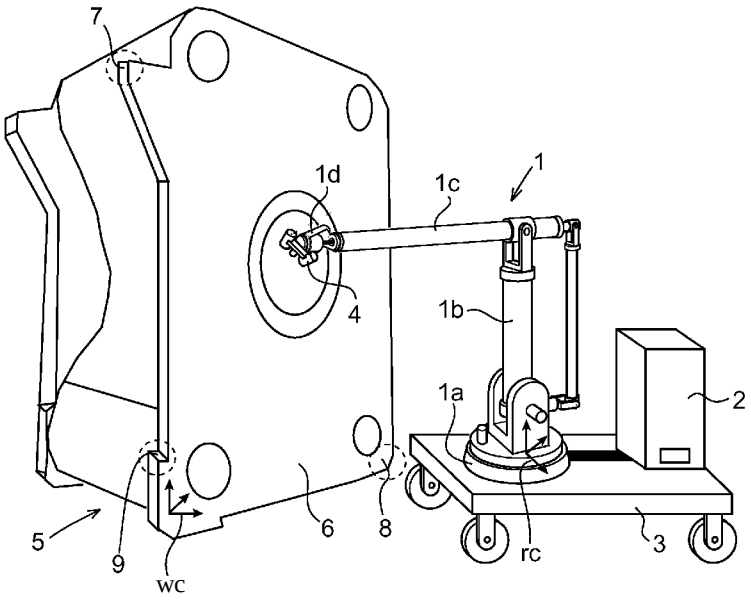

Fig. 1

(57) Abstract: The present invention relates to a method for calibration of a robot (1) positioned on a movable platform (3), in relation to a work object (5) using a measuring unit (4) mounted on the robot. The method includes the following first steps carried out in a software CAD system: - placing CAD models of the platform and the work object so that the robot is able to reach the work object, - manipulating the robot CAD model until the CAD model of the measuring unit is moved to a first pose in relation to the platform allowing measurement of a large feature on the work object, - storing the first pose, and - generating a first CAD model of the large feature based on the CAD model of the work object as seen from the measuring unit in said first pose. The method includes the following second steps carried out in the real world : - automatically moving the real robot (1) to achieve said first pose of the measuring unit, - moving the real platform (3) to a place where measurements of the large feature can be made, - performing 3D measurements of the large feature and based thereon generating a second CAD model of the large feature, - performing a best fit between the first and the second CAD models of the large feature, and on bases thereof calculating the 6 DOF pose difference between the CAD models, and - instructing the real mobile platform to move and reorient to compensate for the calculated pose difference.

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A. CLASSIFICATION OF SUBJECT MATTER
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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)
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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)
EPO-Internal , WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	WANNER M C ET AL: "Off-l i ne programmi ng for the ai rcraft cl eani ng robot SKYWASH", INTELLIGENT ROBOTS AND SYSTEMS '94. 'ADVANCED ROBOTIC SYSTEMS AND THE REAL WORLD', I ROS '94. PROCEEDINGS OF THE I EEE/RSJ/GI INTERNATIONAL CO NFERENCE ON MUNICH, GERMANY 12-16 SEPT. 1994, NEW YORK, NY, USA, I EEE, vol . 3, 12 September 1994 (1994-09-12) , pages 1972-1979 , XP010142038, DOI : 10. 1109/1 ROS. 1994.407593 ISBN : 978-0-7803-1933-2 Secti ons 2.1, 2.2, 2.3 and 3.3.2 -----	1-4
A	EP 1 172 183 A2 (KLECK ROLF [DE]) 16 January 2002 (2002-01-16) the whol e document ----- -/- ·	1-4

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X See patent family annex.

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C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	WO 2009/149740 A1 (ABB TECHNOLOGY AB [SE] ; SVENSSON TOMMY Y [US] ; GUSTAFSSON MAGNUS K [SE]) 17 December 2009 (2009-12-17) the whole document	1-4
A	US 2009/265030 A1 (HUANG BIN [US] ET AL) 22 October 2009 (2009-10-22) paragraph [0059] - paragraph [0067] paragraph [0081] - paragraph [0089] figures 3,4	1
A	EP 1 864 764 A2 (FANUC LTD [JP] FANUC CORP [JP]) 12 December 2007 (2007-12-12) the whole document	1

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INTERNATIONAL SEARCH REPORT

Information on patent family members

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Patent document cited in search report	Publication date	Patent family member(s)	Publication date
EP 1172183 A2	16-01-2002	DE 10133624 Al	24-01-2002
		EP 1172183 A2	16-01-2002
Wo 2009149740 Al	17-12-2009	CN 102119072 A	06-07-2011
		EP 2282873 Al	16-02-2011
		US 2010262288 Al	14-10-2010
		Wo 2009149740 Al	17-12-2009
US 2009265030 Al	22-10-2009	DE 102009017795 Al	22-10-2009
		JP 2009266221 A	12-11-2009
		US 2009265030 Al	22-10-2009
EP 1864764 A2	12-12-2007	CN 101085523 A	12-12-2007
		EP 1864764 A2	12-12-2007
		JP 4238256 B2	18-03-2009
		JP 2007326160 A	20-12-2007
		US 2007282485 Al	06-12-2007