Title: METHOD AND APPARATUS FOR DETECTING OBSTACLES

(57) Abstract: A method and apparatus for detecting obstacles in off-road applications. A stereo camera (202) and specific image-processing techniques (300) enable a vehicle’s vision system to identify durable terrain in front of the vehicle. The method uses non-drivable residuals (NDR), where the NDR is zero for all terrain that can be easily traversed by the vehicle and greater than zero for terrain that may not be traversable by the vehicle. The method utilizes a depth map (304) having a point cloud that represents the depth to objects within the field of view of the stereo cameras (200, 202). The depth map (304) is tiled such that the point cloud data is represented by an average (smoothed) value. The method scans pixels in the smoothed depth map to find sequences of “good” points that are connected by line segments having an acceptable slope. Points that lie outside of the acceptable slope range will have an NDR that is greater than zero. The vehicle control system (306) can use the NDRs to accurately make decisions as to the trajectory of the vehicle.
INTERNATIONAL SEARCH REPORT

A.  CLASSIFICATION OF SUBJECT MATTER
   IPC:  G06F 17/10( 2006.01)

   USPC: 701/207,208,212,300,301; 340/435,436,995.2,961,963
   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)
   U.S.: 701/207, 208,212,300,301; 340/435,436,995.2,961,963

   Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
   NONE

   Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
   WEST: depth map, regions, detect obstacles mobility, vehicle constraint

C.  DOCUMENTS CONSIDERED TO BE RELEVANT

<table>
<thead>
<tr>
<th>Category</th>
<th>Citation of document, with indication, where appropriate, of the relevant passages</th>
<th>Relevant to claim No.</th>
</tr>
</thead>
<tbody>
<tr>
<td>X</td>
<td>US 5,448,233 A (SABAN et al) 05 September 1995 (05.09.1995), col. 3, lines 65-68-col. 4, lines 1-9) Figs. 4A-4E</td>
<td>2-6</td>
</tr>
<tr>
<td>Y</td>
<td></td>
<td>9-10</td>
</tr>
<tr>
<td>X</td>
<td>US 5,530,651 A (UEMURA et al) 25 June 1996 (25.06.1996), col. 3, lines 30-32; col. 13, lines 4-19.</td>
<td>1</td>
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<tr>
<td>Y,A</td>
<td>Figs. 4A-4E</td>
<td>7-8</td>
</tr>
</tbody>
</table>

☐ Further documents are listed in the continuation of Box C.  ☐ See patent family annex.

* Special categories of cited documents:
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   "P" document published prior to the international filing date but later than the priority date claimed
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   "&" document member of the same patent family

Date of the actual completion of the international search 27 July 2006 (27.07.2006)

Date of mailing of the international search report 19 MAR 2007

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