**Report of 3-Point and 5-Point Algorithm**

Student’s Name: Dinh Vu Student’s ID: 20184187

1. **Three-Point Perspective Algorithm**
   1. ***The problem***

In 3D space, given the perspective projection of three points of a known triangle, the position of each of the vertices can be obtained.

(a, b, c) is known, can be determined from the unit vectors .

The length of and position of must be estimated.



**Figure 1.1.** Illustrate the geometry of the three point space resection problem

* 1. ***The solutions***

There are six solutions presents by Grunert (1841), Finsterwalder (1937), Merritt (1949), Fischler and Bolles (1981), Linnainmaa (1988) and Grafarend (1989).

**Table 1.1.** Summarize of six solutions

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Solutions** | **Change of Variables** | **Pairs of Equations** | **Variable Reduction** | **Solve New Variables** |
| Grunert |  | (1, 2), (2, 3) | Substitution |  |
| Finsterwalder |  | (1, 2), (2, 3) | Introduce a new variable | Set a perfect square into zero |
| Merritt |  | (1, 2), (1, 3) | Sustitution |  |
| Fischler and Bolles |  | (1, 2), (1, 3) | Elimination |  |
| Linnainmaa |  |  | Elimination |  |
| Grafarend |  | (1, 3), (2, 3) | Introduce a new variable | Set an eigensystem into zero |

1. **Five-Point Algorithm**
   1. ***The problem***

Given the normalized image coordinates of five matching points, and , in two images, the camera matrix must be estimated from them. Before jump to algorithm, three conditions must be considered.

Where: and is the essential and fundamental matrix, respectively.

* 1. ***The solutions***

If 5 points are stacked, (2.1) become: . Where:

Therefore:

* Step 1: Extraction the nullspace of a 5×9 matrix
* Step 2: Expansion of the cubic constraints (2.2) and (2.3)
* Step 3: Gauss-Jordan elimination with partial pivoting on the 10×20 matrix
* Step 4: Expansion of the determinant polynomial of the 3×3 polynomial matrix to obtain the tenth degree polynomial
* Step 5: Extraction of roots from the tenth degree polynomial
* Step 6: Recovery of and corresponding to each real root and point triangulation for disambiguation

where and . Then and ,

There are 4 possible solutions for camera matrix: