Project „Flexible Assembly Processes for the Car of the Third Millennium (MyCar)“

Methodology Description (High Level)

Vision System (for monitoring) integrated in
RLW joining operations

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How to implement a flexible low cost and generic vision system for the control of robotic welding operations?

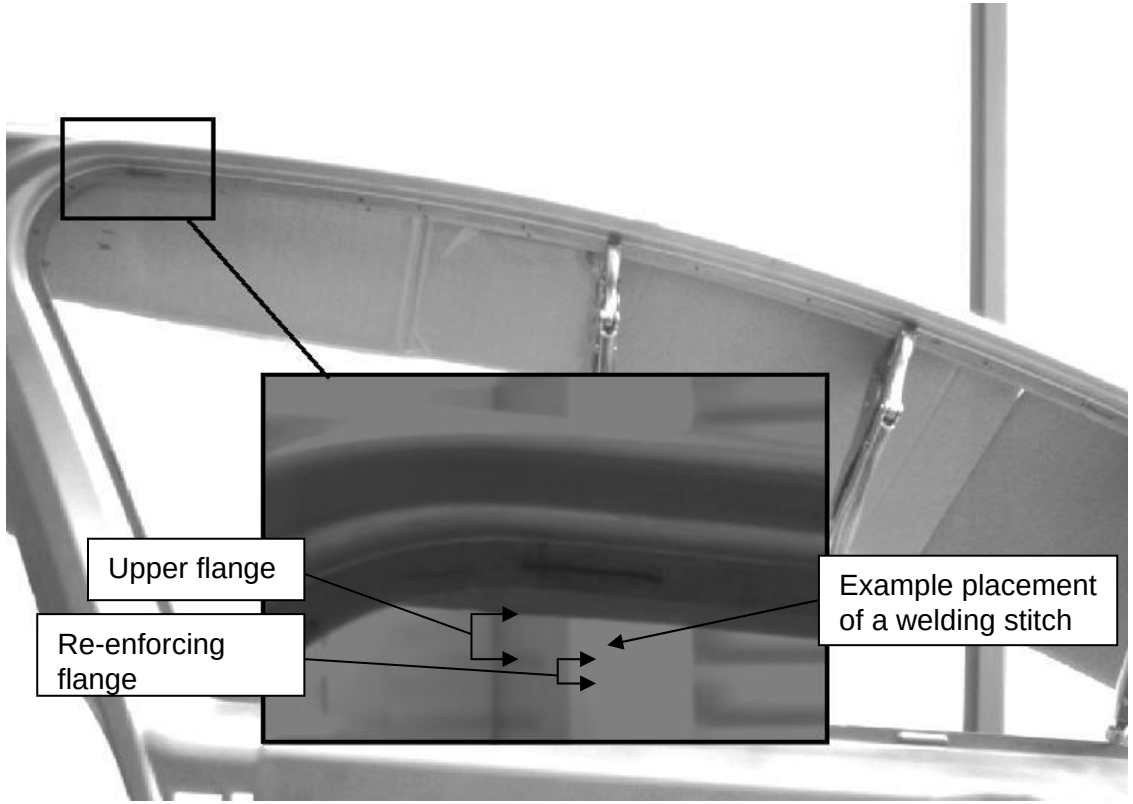
Available results

Stereoscopic vision system for the control of welding process performed by robots:

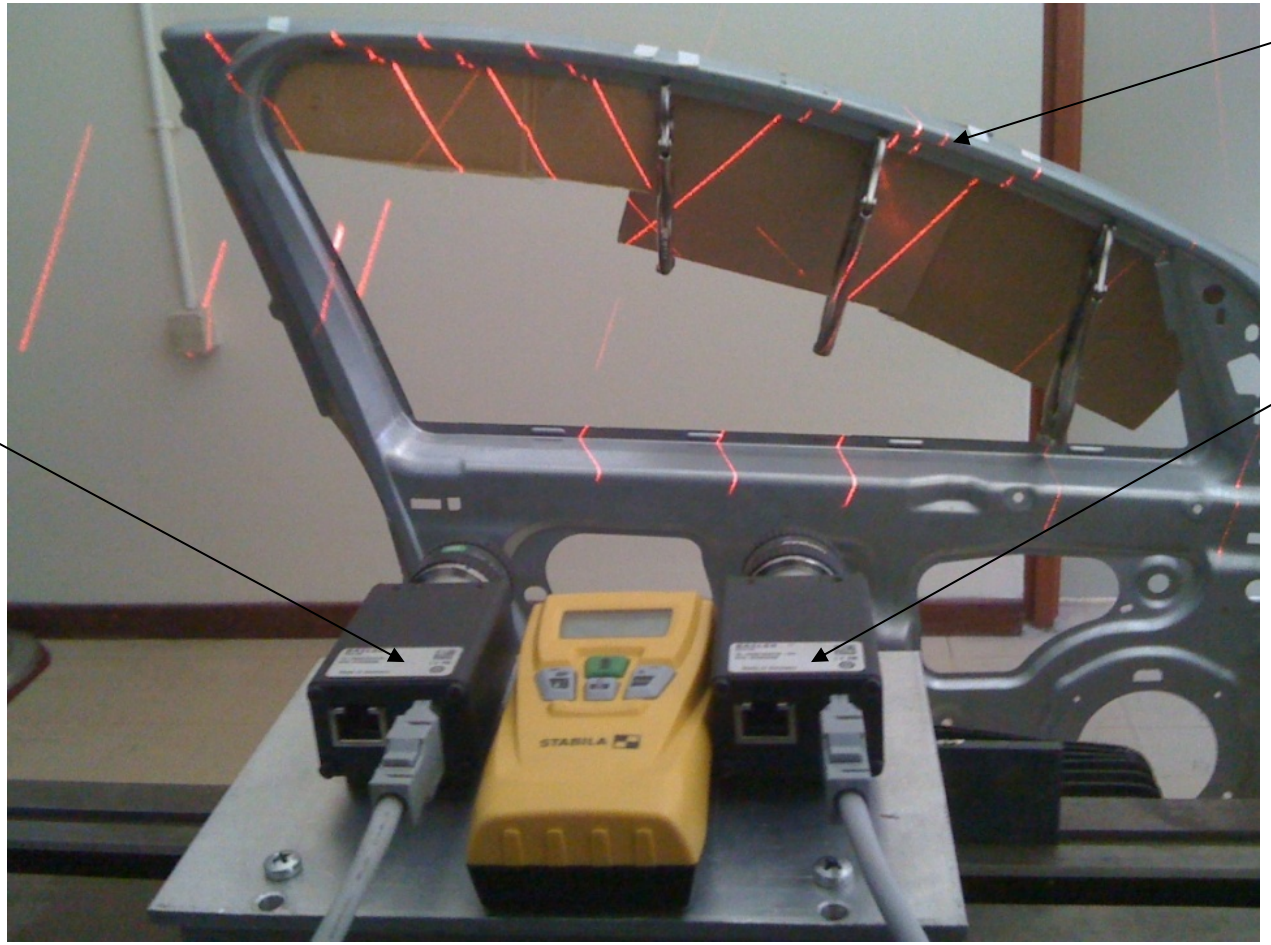
- Purpose of vision system: control of a remote laser welding station

- 3D location of the points on the car door where the welding stitches will be performed.

- Necessary system characteristics:
  - Accuracy = 0.5-1mm
  - Rapid reading time
  - Cost effective

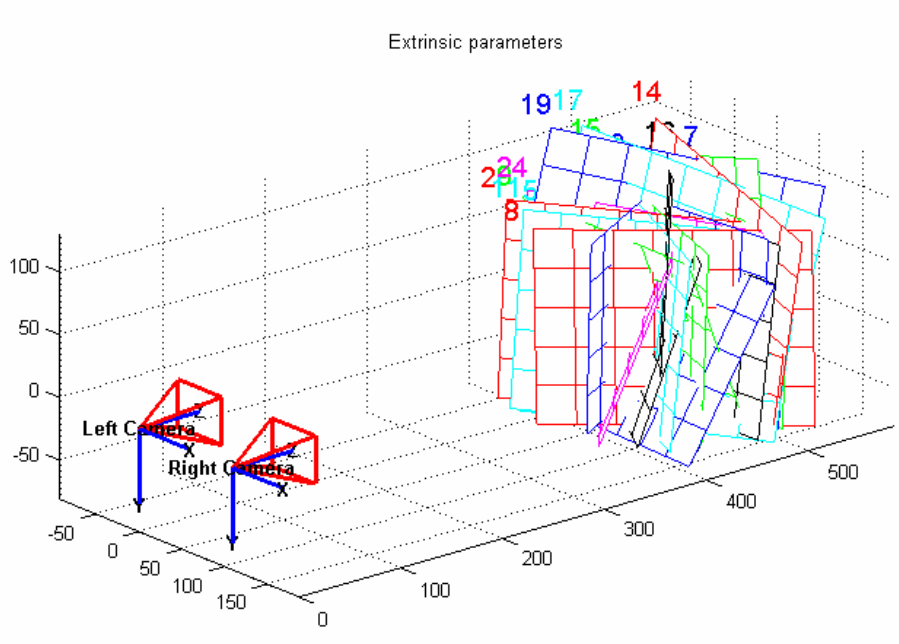


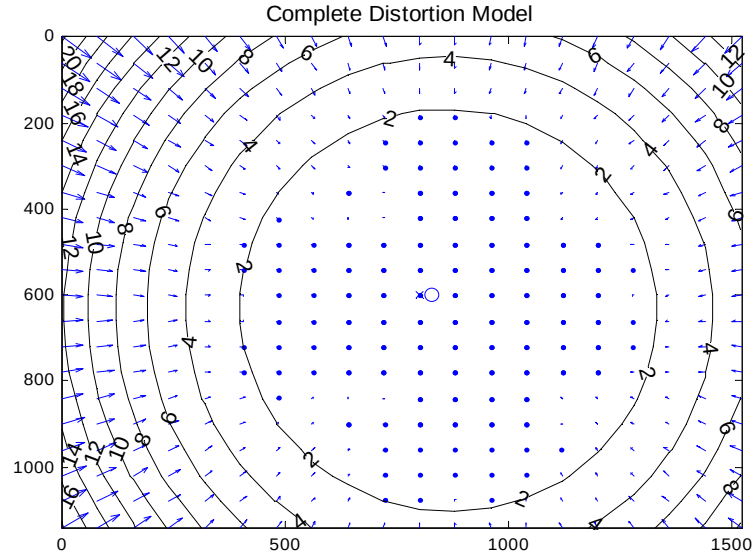
Experimental Setup



Step 1: System Calibration

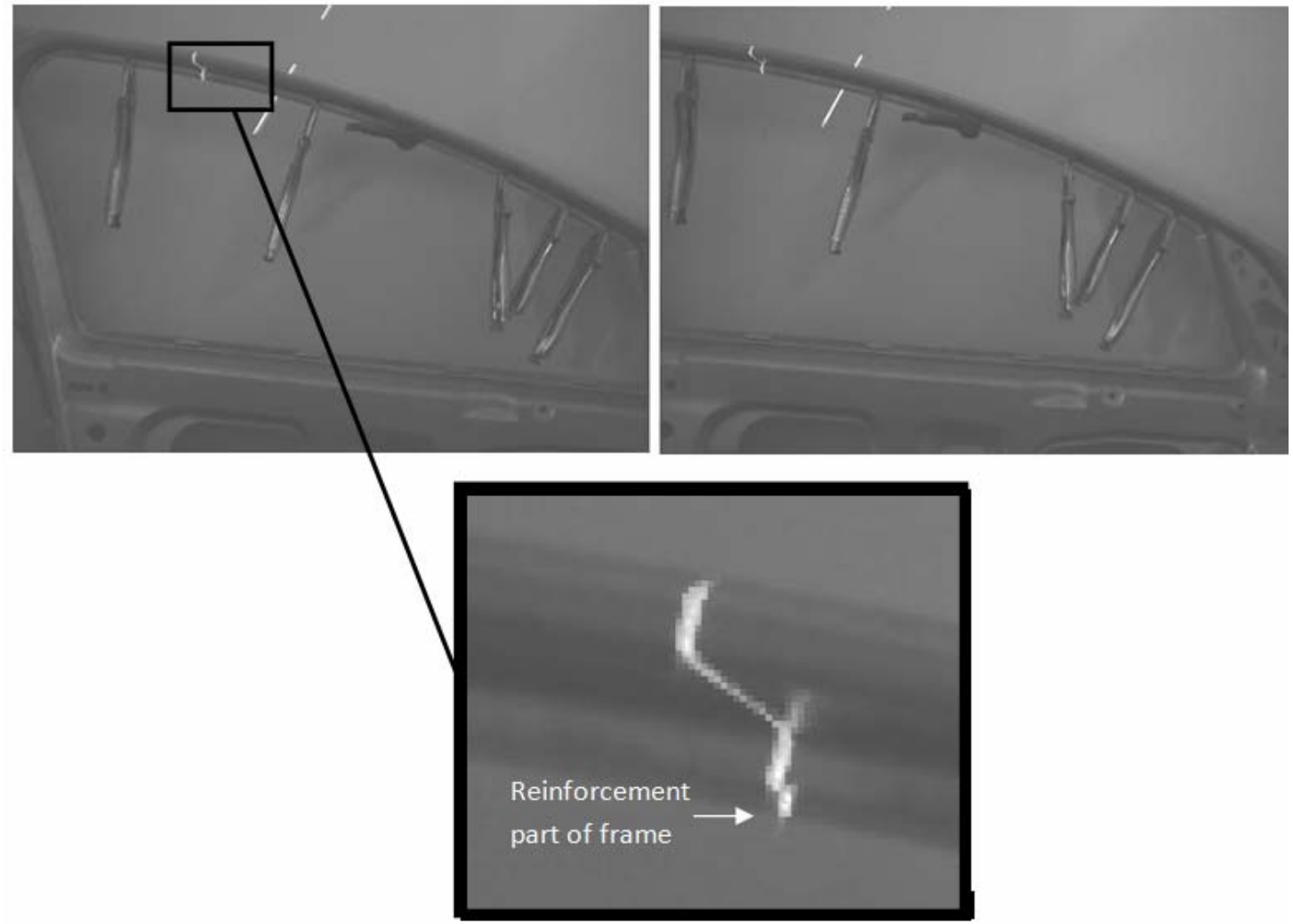
Define intrinsic and extrinsic characteristics of the camera system





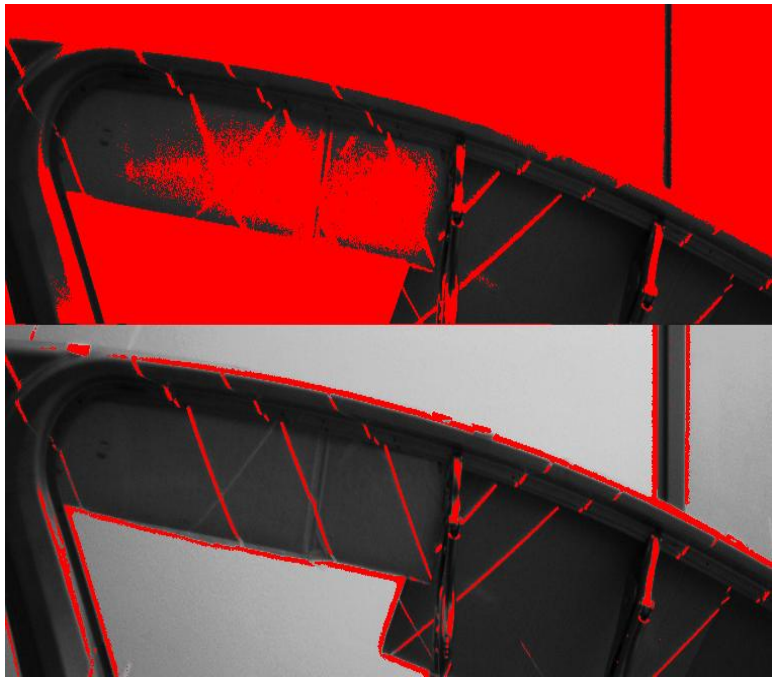
Pixel error	= [0.1306, 0.0998]	
Focal Length	= (1882.59, 1886.11)	+/- [2.286, 2.178]
Principal Point	= (826.749, 599.748)	+/- [4.616, 3.847]
Skew	= 0	+/- 0
Radial coefficients	= (-0.0729, 0.03159, 0)	+/- [0.01009, 0.107, 0]
Tangential coefficients	= (0.001323, 0.001474)	+/- [0.0006495, 0.0007604]

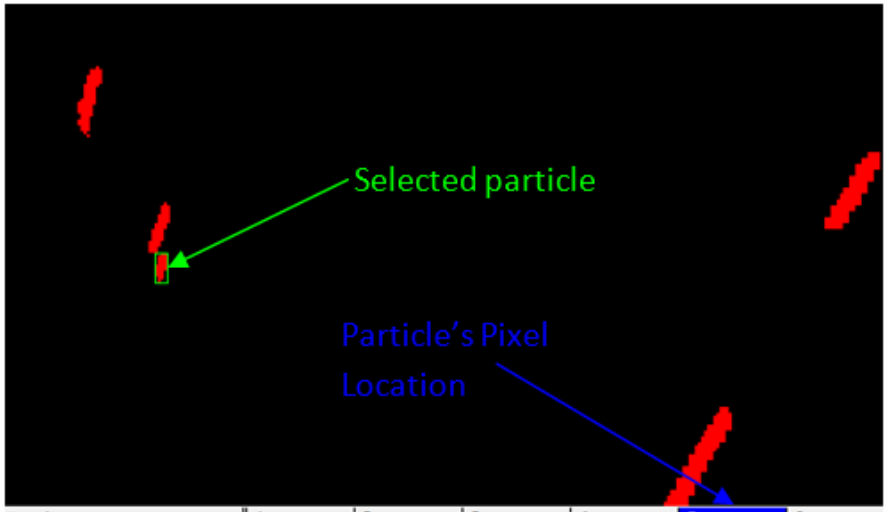
Step2: Acquire Images from Cameras



Step 3:Threshold Selection & Particle Analysis

Use particle analysis to solve the correspondence problem

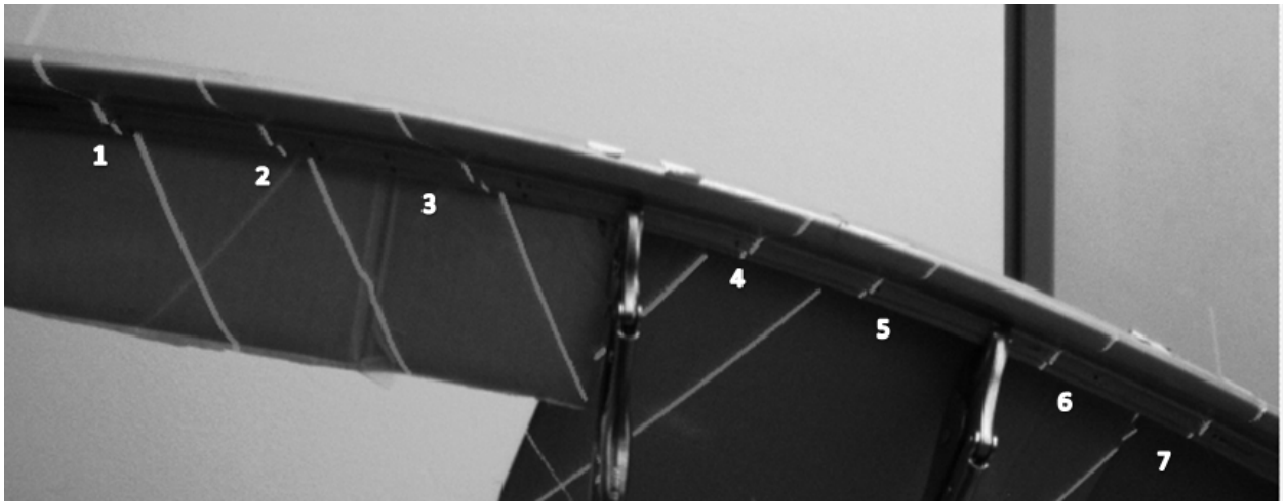




Results ...	1	2	3	4	5	6
Center of Mass X	786.95238	454.25532	701.91011	477.16667	477.60714	634.42060
Center of Mass Y	18.59127	140.70213	171.97191	184.45000	197.21429	294.67096
First Pixel X	795.00000	457.00000	707.00000	479.00000	478.00000	659.00000
First Pixel Y	0.000000	130.00000	159.00000	176.00000	193.00000	245.00000

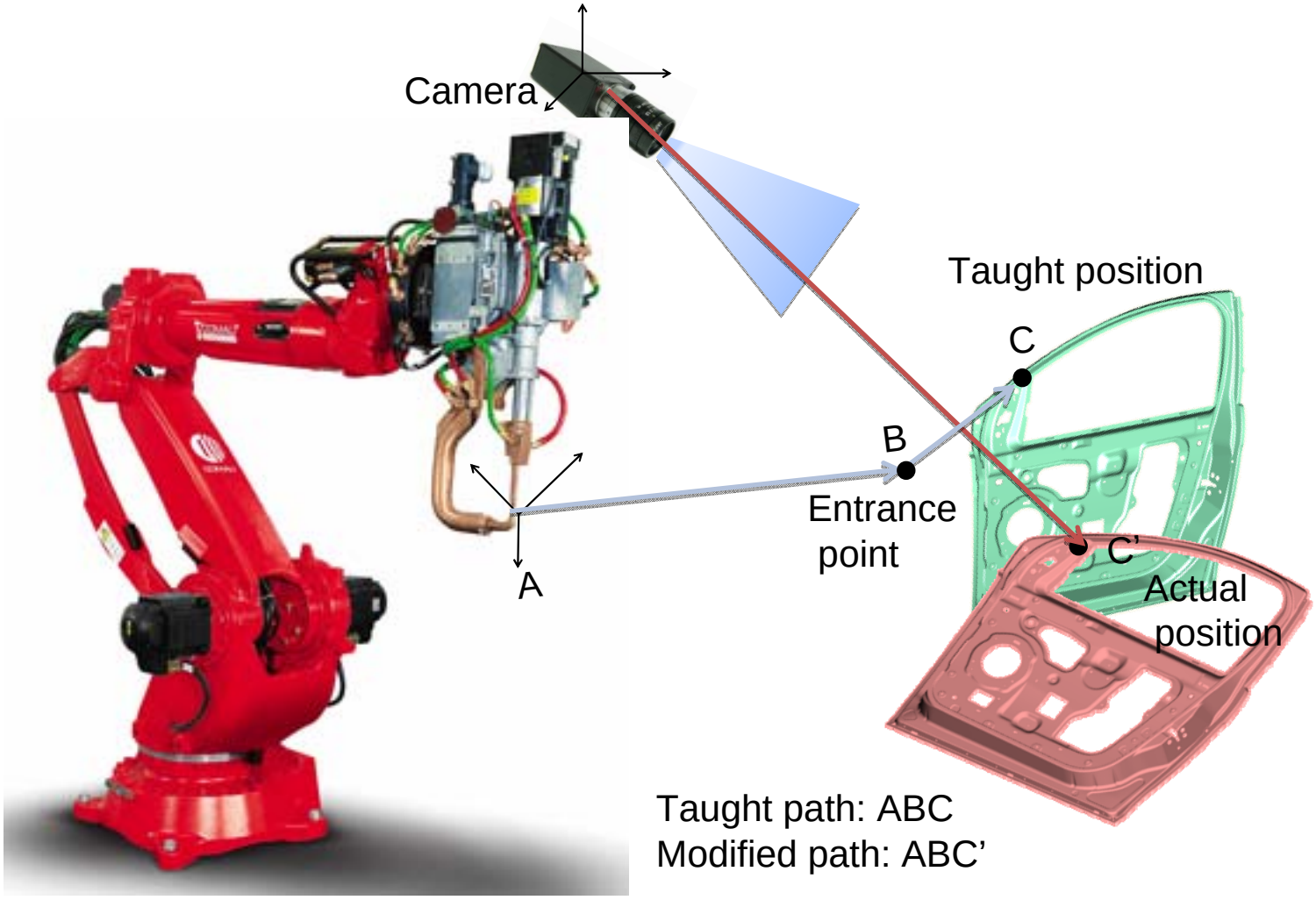
Step 4: Path correction

Calculate the coordinates of the stitches and the error from the nominal position



				Calc. Location			Error		
Point	camera	x pixel value	y pixel value	x	y	z	x	y	z
1	left	414.5	730.5	-185.485	59.8896	851.3111	7.3347	1.1104	9.2319
	right	162.3529	732.4706	-294.591	58.9396	851.1788	6.7407	2.0604	9.3642
2	left	405.1154	623.6539	-185.345	11.1697	831.646	7.1948	-0.1697	26.897
	right	148.3333	626.125	-294.144	10.1888	831.5951	6.2937	0.8112	26.9479
…	…	…	…	…	…	…	…	…	…

Step 5: Correct the robots' motion



Taught path: ABC
Modified path: ABC'

Benefits of the approach

- Expected benefits:
  - Flange width reduction – weight reduction
  - Enhanced weld quality
  - Reduction of the amount of steel used for the parts
  - Applicability in many similar parts