Dipartimento di Ingegneria Meccanica per l'Energetica

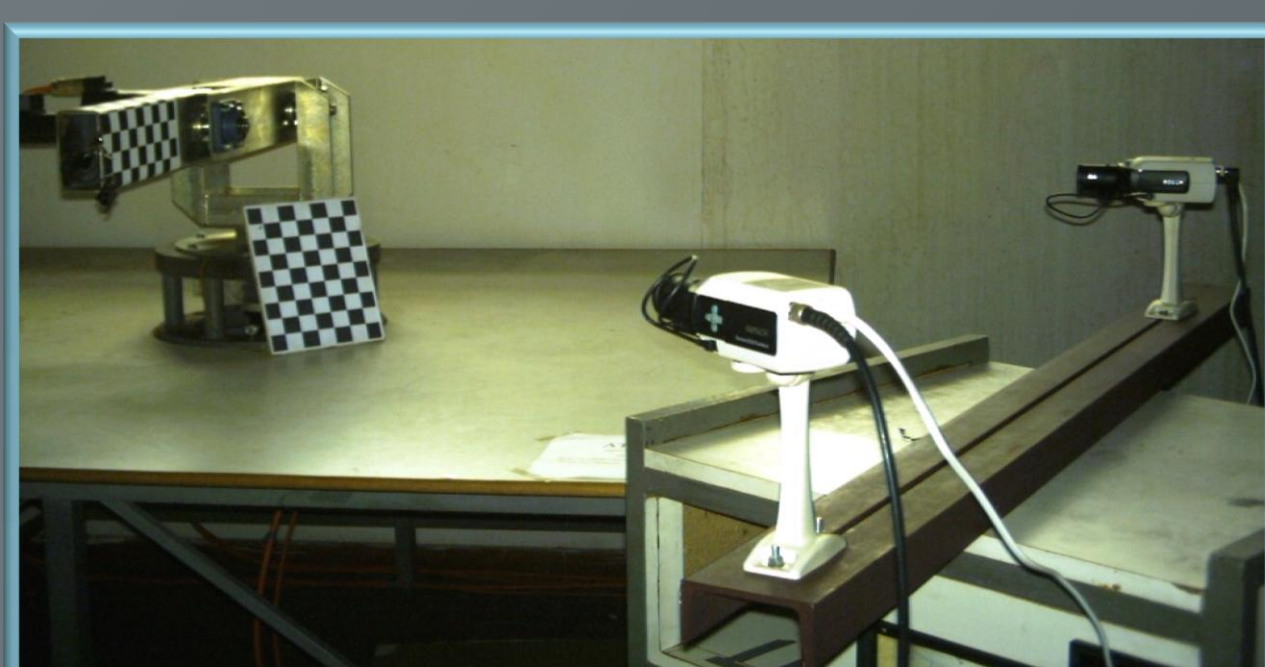# Università degli Studi di Napoli Federico II

Video Applications for Robot Arms

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Robot mechanical calibration

The technique is based on the recordings of a couple of television cameras

The stereoscopic vision system

A target is located on the last link of a robot arm and its trajectory is recorded by the camera

Target position

The joint positions, obtained from the encoder, related to each of the couples of frames, is also recorded.
By analyzing a number of couples of frames, it is possible to compute the Denavit and Hartemberg parameters.

real prototype D-H parameters

Joint	a_i	α_i	θ_i	d_i
1	0	90	-180 180	l_1= 449mm
2	l_2= 400mm	0	-90 45	0
3	l_3= 400mm	0	-90 90	0

calculated prototype D-H parameters

Joint	a_i	α_i	θ_i	d_i
1	7.04mm	86.28	-180 180	l_1= 447.15mm
2	l_2= 396.16mm	0.94	-90 45	10.85mm
3	l_3= 413.65mm	0	-90 90	13.75mm

Shape acquisiton with active triangulation

The 3D information is obtained knowing the relative position between the camera and the laser beam projector. In this way, by means of the triangulation procedure, it's possible to calculate the coordinates in the camera frame of the points of the laser line in the image plane.
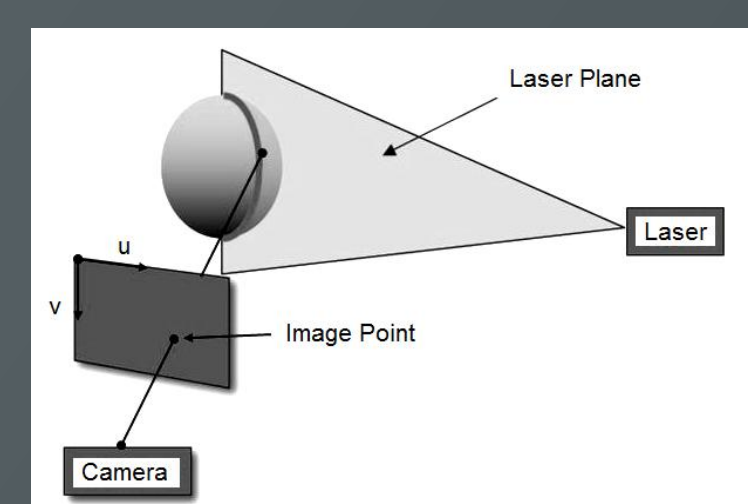

Sketch of the laser-camera system

Robot scanning system

The robot serves as a measuring device to determines the scanning window position and orientation in the base reference frame with a great precision. In this way all the points defined in different camera frame position are expressed in a single frame.

The technique has been automated by developing an interactive GUI to acquire and to elaborate data.
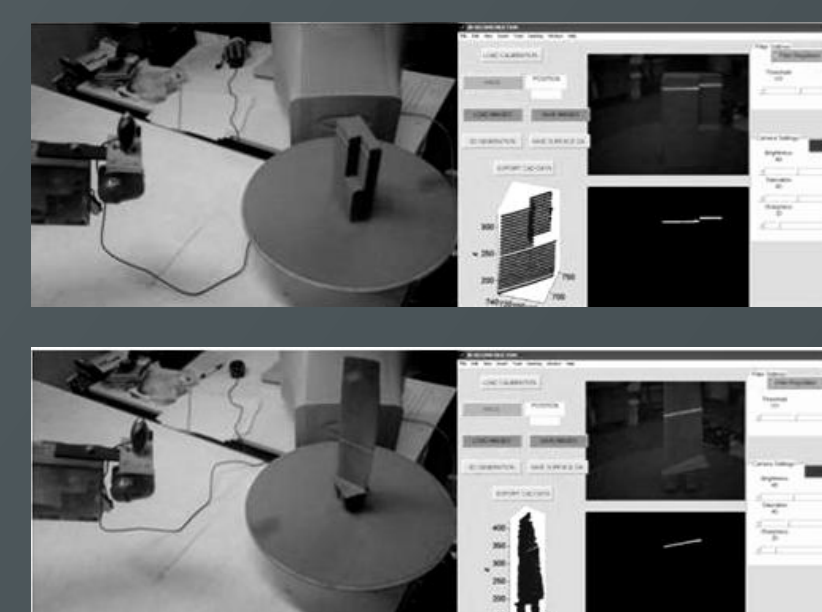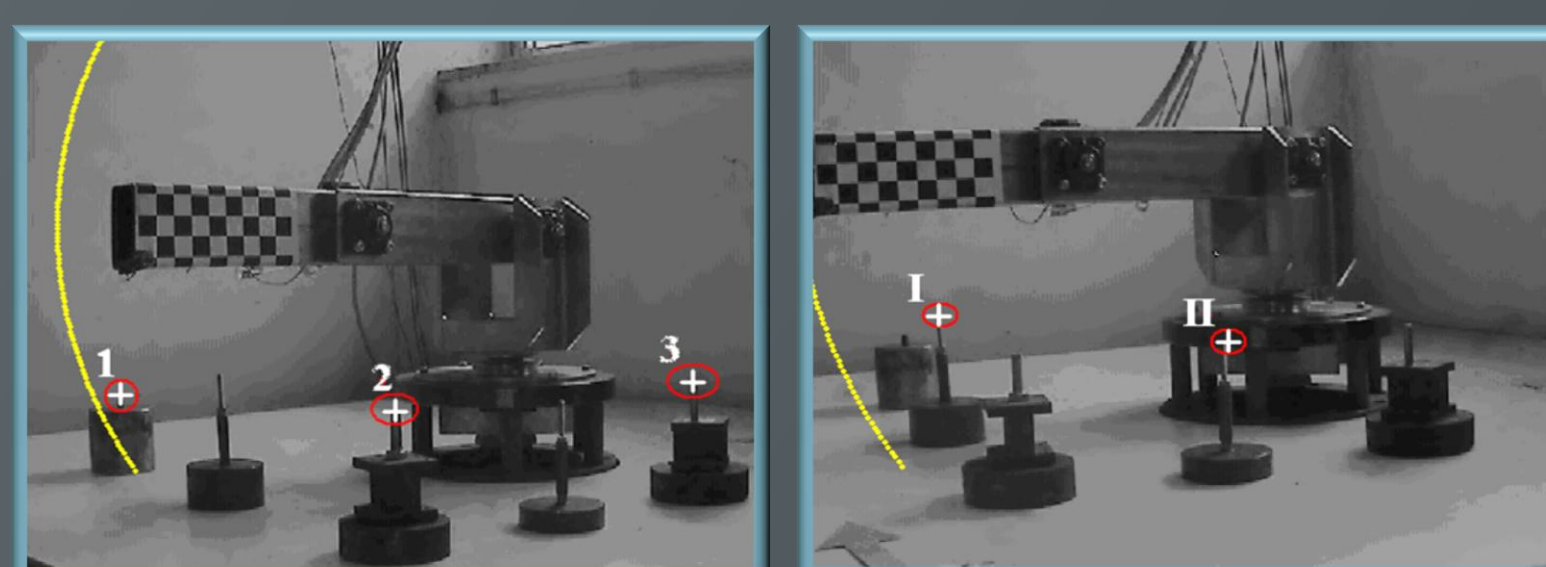

Interactive GUI
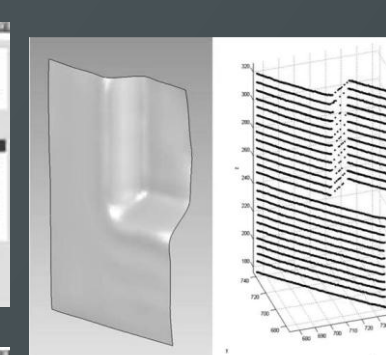
CAD model

With the use of the software CATIA it's possible to build the CAD model of the scanned object.

Path planning

Was developed a software that allows to choose the end-effector trajectory points. By means of this software, it is possible to select "objective" points, for which the robot must journey, and "obstacle" points, that must be avoided.
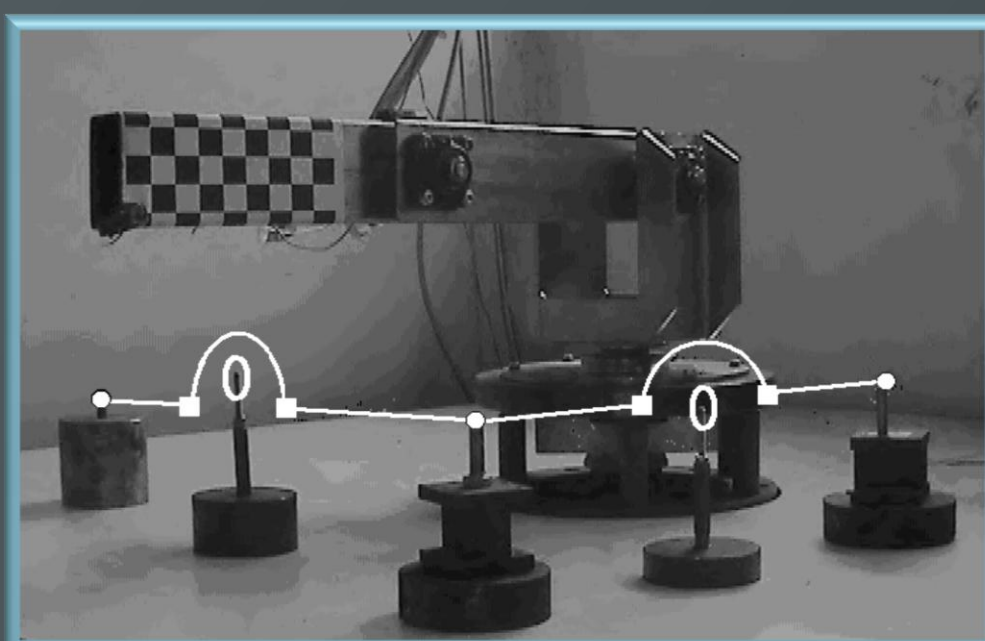

Path assigning

The software recognizes the positions of such points in the work space, using a developed camera model

The procedure starts from a couple of images (taken from two different cameras).

The operator has the possibility to choose the assigned points by clicking on the two images
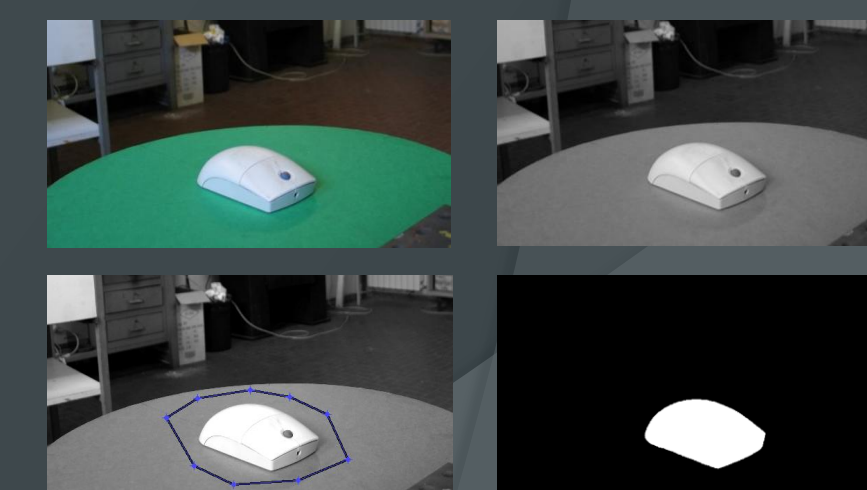

Example of path in the work space

A shape from silhouettes method application

A technique is proposed by means of which it is possible to obtain the three dimensional reconstruction of objects using their silhouttes.
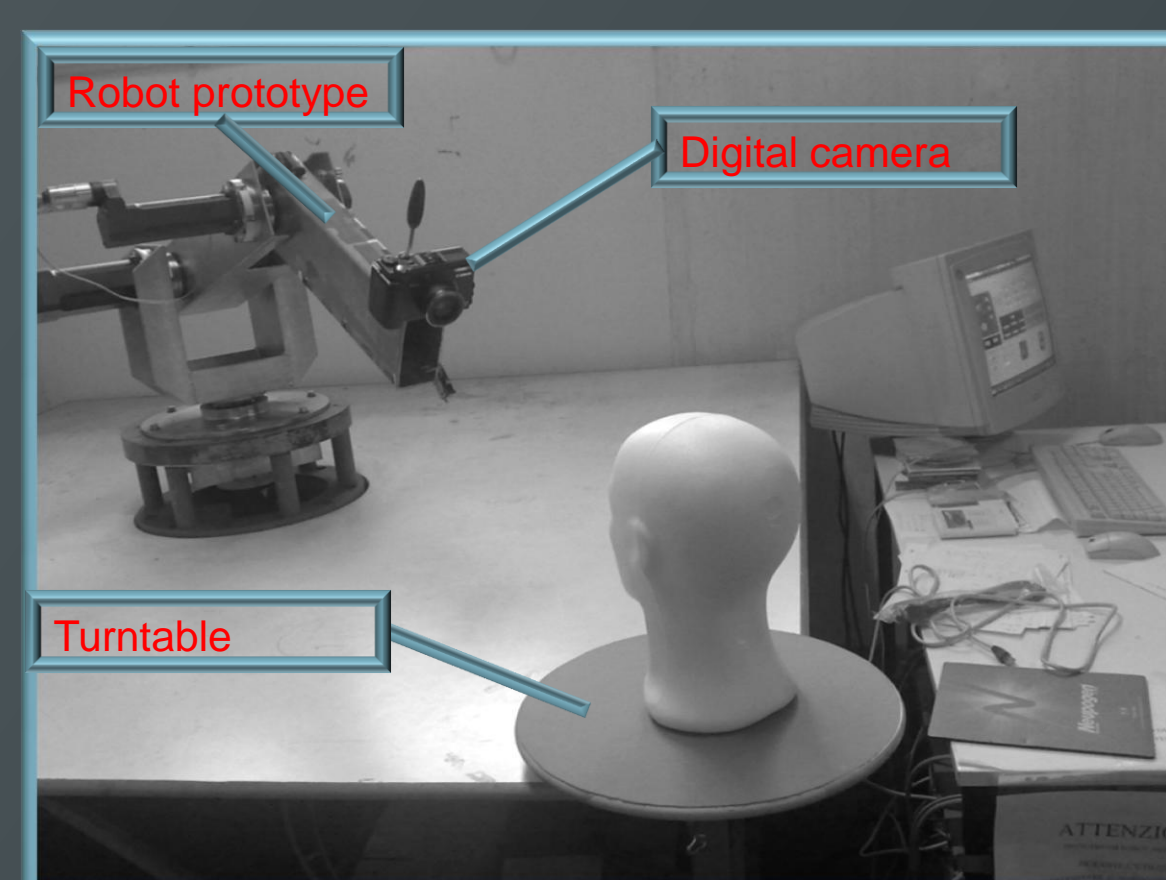
Acquisition system

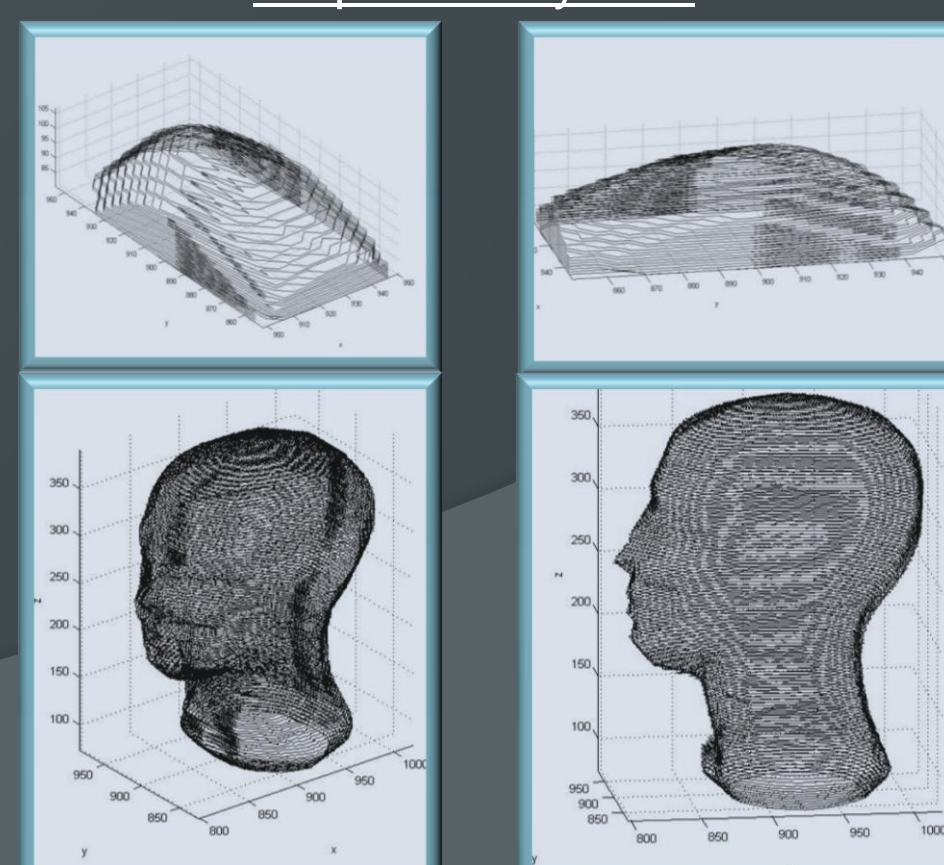This technique uses a number of images from a single camera that is moved around the object by a robot arm.

By means of the turntable, it is possible to rotate the object, around a vertical axis, of a known angle

It is possible to reproduce the object form:
➢ in any point of the robot workspace
➢ in any position
➢ with any scale factor

Robot trajectories to reproduce a computer mouse and a mockup head

This technique can be used to make a copy of the object itself by means of a tool fitted on the robot arm