***How to handle the gripper offset in picking operations***

The following applies to any four or six axis robots:

Given that

The (XY0r) sample object position as seen by the camera mounted on the Z-axis.

Taught (XYZR) pick up position of the sample including the height and orientation.

Obtained by “*here BTG*” after carefully maneuvering the gripper to the sample.

Find -

The gripper offset from the Z axis as determined by calibration, calculation, or by

“*set ZTG = inverse(BTO) : BTG*”.

 The variable pickup position obtained from the variable BTO and the fixed ZTG:

, or

“*set BTP = BTO : inverse(ZTG)*”.

**Notes:**

1. comes from the Lab 3 result, and is the same as *OBJ.LOC* expressed in the robot base term.
2. In a SCARA robot, ZTG can precisely be set by an updated calibration procedure by Dr Regalbuto which involves two mirrored pick up positions, 180̐° apart with a pivot on the calibration point. The exact ZTG transformation data will be published following the procedure.

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1. The gripper offset can also be set up as a transformation matrix in the form of

 where g = gripper offset angle, dx = offset distance

1. The following helpful relationship exists between the gripper roll angle, r, and the joint angles for the SCARA robot:

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where *θ4*, the joint 4 angle, is relative to joint 2 and *r* is relative to the robot base. When the gripper is offset from the Z axis, the pick up or drop off position must be compensated for the offset value using . This applies to the Lone Star extra credit project, of course.