Implementation of NIST’s Restoration of Rigid-Body Condition (RRBC) Method

System Integrator consults with User

Determine:
1. User applications
2. Accuracy requirements
3. Sensors used
   - RRBC applicable if
     (sensor bias/sensor noise) > 2.5
4. Number of fiducial points

System Integrator develops software

User executes software

System Integrator and User Responsibilities

**User**
1. Measures registration points with robot and with sensor
2. Determines and measures nominal/expected locations of objects (target points) with sensor
3. Determines variability of object placement in work volume

**Sensor**
Location of target points

**Software**
(System Integrator)
Corrected target point locations

**Robot path planner**
Software Developed by System Integrator

Registration points in robot and sensor frames

Registration Module: determine transformation matrix, \((R, \tau)\)

Determine distance from fiducial pt. to target pt. based on variability of object placement and level of accuracy needed.

Determine locations of fiducial points, in robot frame, around each target, \(Y_n\)

Send command to robot to move to fiducial pts.

Trigger sensor to measure fiducial points, \(X_n\)

Apply inverse of transformation matrix, \((R, \tau)^{-1}\), to \(Y_n\) to transform points to sensor frame.

Calculate corrections, \(e_n\), for each fiducial

\[
e_n = (\text{transformed, robot-measured, fiducial pt.}) - (\text{sensor-measured, fiducial pt.}) = R_{inv}Y_n + \tau_{inv} - X_n
\]

Determine weighted corrections for each target

\[
e(T_X) = \sum_{n=1}^{N} w_n \cdot e(X_n)
\]

Calculate corrected target locations

\[
\hat{T}_X = T_X + e(T_X)
\]

Apply transformation matrix, \((R, \tau)\), to \(\hat{T}_X\).

Target points from sensor, \(T_X\)

Determine weights \((w_n)\) based on proximity to target location for each fiducial correction.

Robot path planner

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