**Robotic Disassembly/Assembly NIST Task board 3 BENCHMARK**

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| Reference No / VersionURLAuthors Institution  | RAL-SI-2020-B-3 [Benchmarking Protocols for Evaluating Small Parts Robotic Assembly Systems]-V1.0 |
| <https://www.nist.gov/el/intelligent-systems-division-73500/robotic-grasping-and-manipulation-assembly/assembly> |
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| Adopted Protocol | RAL-SI-2020-P [Benchmarking Protocols for Evaluating Small Parts Robotic Assembly Systems]-V1.0Kenneth Kimble1, Karl Van Wyk2, Joe Falco1, Elena Messina1, Yu Sun3, Mizuho Shibata4, Wataru Uemura5, Yasuyoshi Yokokohji61National Institute of Standards and Technology (NIST), 2NVIDIA, 3University of South Florida, 4Kindai University, 5Ryukoku University, 6Kobe University  |
| Scoring |

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| Assembly |   |   |   |   |   |
| Description | Qty | Task 1 | Task 2 | per task | Total |
| Wire transport | 12 | Contact with board |   |   | 12 |
| 1 pt |   | 1 |
| Pin insertion | 24 | inserted | seated |   | 72 |
| 2 pts | 1 pt | 3 |
| Wire routed  | 12 | elastic retainer | corner post |   | 60 |
| 1 pt each | 1 pt each |   |
| \_\_\_\_ / 3 | \_\_\_\_ / 2 | 5 |
| Wired correctly | 6 | connector LED is lit |   |   | 18 |
| 3 |   | 3 |
|   |   |   |   | Max score: | 162 |

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| Disassembly |   |   |   |
| Description | Qty | Task 1 | Total |
| Wires bundled | 5 | Bound at each retainer | 25 |
| 5 pts |
| Connector detach | 8 | Removed from joining part | 24 |
| 3 pts |
| Harness removal | 1 | Fully removed from board | 5 |
| 5 pts |
|   |   | Max score: | 54 |

Example of a fully assembled task board. Corresponds to the set-up just prior to the disassembly task or an assembly trial with 100% completion. |
| Details of Setup | Describe your system design including robots and end-effector technologies used, perception type and how it is used to localize board, kit and components, use of CAD. Also describe all tools used with end-effectors. |
| Results to Submit | Submit scoresheets and a summary of results over 32 trials to include analysis of speed, completion, and reliability. Make notes in the summary of the incomplete/failed tasks and the reasons for the failure. Speed is measured as the completion time of a task board as:Ttaskboard = Tfinish − Tstart.Task board completion should be reported as the percentage of total points received for each task board for disassembly and assembly. % Assembled = Total Score/162 x 100% Disassembled = Total Score/54 x 100For each set of 32 trials, compute the mean, standard deviation, and 95% confidence interval of the completion times, disassembly completion and assembly completion. Reliability can also be captured as the probability of successfully completing a task or sub-task. The theoretical upper bound probability for successfully inserting a component (PS) is calculated given a confidence level (CL), the number of successes (m), and the number of independent trials (n). Given the binomial cumulative distribution function:The PS is its minimum value to some precision while still satisfying the above inequality |