

Visual Servoing for Advanced Micro Assembly

Research framework

This work focuses on **the combination of 2D and 3D visual servoings for automatic performing of micro assembly applications**. Structures targeted measure $400\pm 1.5\mu\text{m} \times 400\pm 1.5\mu\text{m} \times 100\pm 1.5\mu\text{m}$ and must be inserted in their grooves of $100\pm 1.5\mu\text{m} \times 100\pm 1.5\mu\text{m} \times 100\pm 1.5\mu\text{m}$. The mechanical play varies between 0 and $3\mu\text{m}$. The corresponding setup comprises a large number of resources: a carrier for structures (xy α robot), a carrier for the gripper (z ϕ robot), a 2-fingers gripper, a computer controlled zoom vertical microscope and a lateral microscope. Assembly sequences include a large number of tasks: gripping, release, displacement, gripper opening, gripper closing, zooming in, zooming out, ... The visual servoings to implement require a level of precision consistent with the mechanical play, and a high level of robustness.

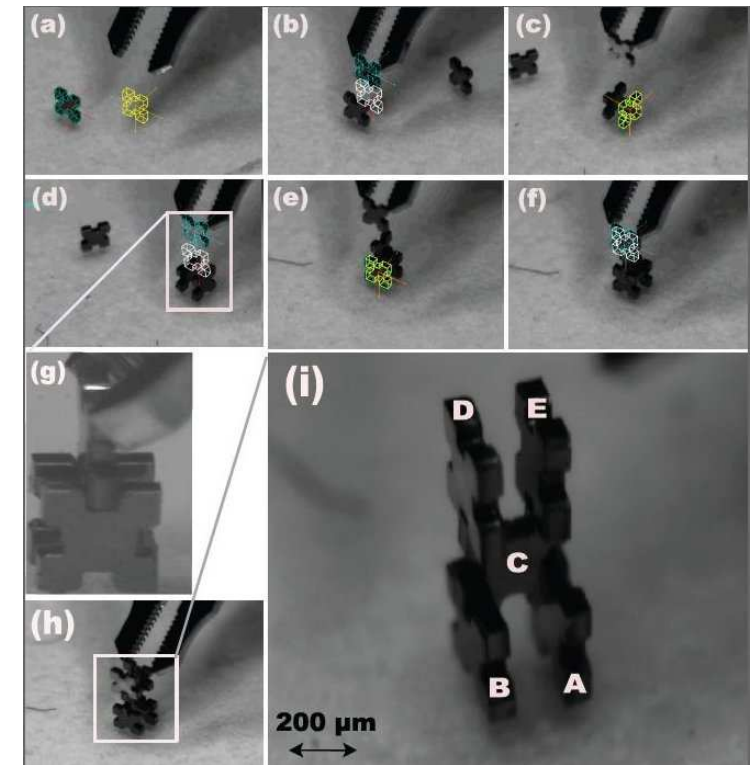
Proposed approach

The critical tasks of structures gripping and release have been assigned to a specific resource (vertical microscope, 2D visual servoing) because of the high level of precision of 2D visual servoing. Tracking the 2D position of keypoints (the four corners of the visible face) is performed using the ESM algorithm from Malis. The displacement tasks were assigned to another specific resources (lateral microscope, 3D visual servoing) because of the level of robustness of the 3D visual servoing. Tracking the 3D position of each structure is achieved using ViSP. In both cases (2D and 3D visual servoings), the control law is the exponential decrease of the error between the current and desired positions.

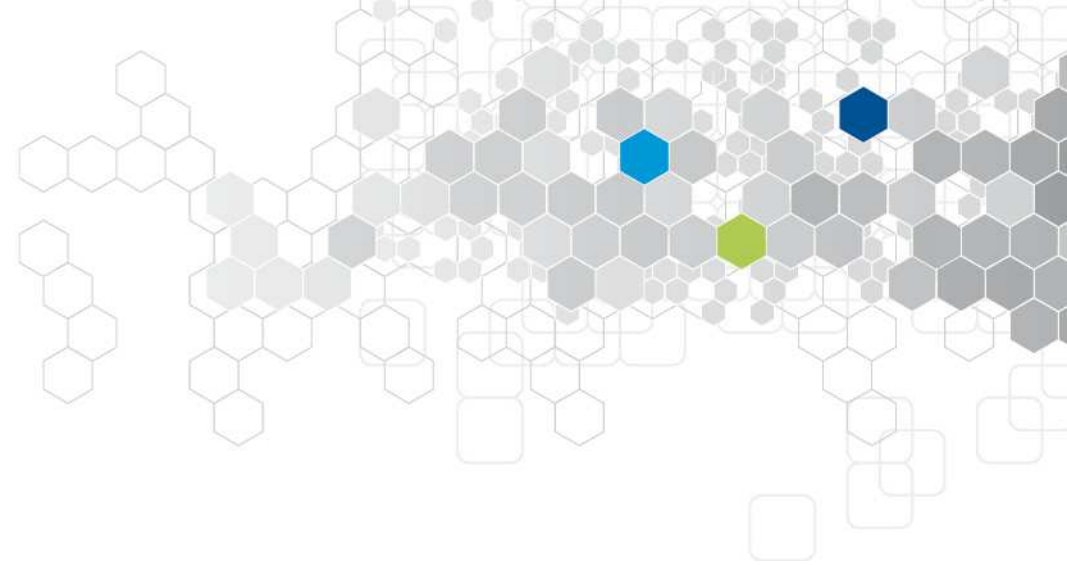
These principles have been applied successfully, thus showing their relevance for micro-structures assembling at this particular scale.

Major article: Tamadazte, B.; Marchand, E.; Lefort-Piat, N. & Dembélé, S. CAD model based tracking and 3D visual-based control for MEMS microassembly International Journal of Robotics Research, 2010, 29:1416-1434.

Contact: nadine.piat@ens2m.fr , soukalo.dembele@femto-st.fr



Some shots taken during the assembly of 5 structures by their U-grooves measuring $100\pm 1.5\mu\text{m} \times 100\pm 1.5\mu\text{m} \times 100\pm 1.5\mu\text{m}$



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