Test Project

Additive Manufacturing

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WSC2026_TP57_en

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Introduction

This Test Project is based on actual reverse engineering and additive manufacturing tasks of real industrial companies and balanced according to WorldSkills Occupational Standards of the Additive Manufacturing skill competition.

The Test Project is a set of modules, that allow the evaluation of the skills and abilities of the Competitors in such areas as:

- 3D model optimization
- 3D scanning, 2D digitizing and manual measurements
- Scan-to-CAD process by incomplete data
- CAD modelling
- 3D printing

The order of Test Project modules can be determined by the queue for certain types of equipment on the Competition site (e.g. The scanning station). To organize the order of teams is a team challenge.

Evaluation is carried out both with respect to the modules themselves and with respect to the process of performing the competitive work.

For the competition, the Competitor must create a competition folder on their computer that is shared with the judging team the name of the folder must be **WSC2026**_*Competitior number*_**WS57**. For each module, the Competitor must create a separate folder in the main folder with the name **WSC2026_TP57_Module [module number]** and copy all the module materials into it before the end of the time allotted to the module. Otherwise, his module work will not be checked and the module considered not performed.

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Description of project and tasks

This Test Project focuses on the topic of 3D printing for lightweight robot end effectors. In an increasing number of factories around the world, conventional grippers are being replaced by lightweight variants, or new projects are being started directly with modular lightweight approaches. Compared to classic solutions, which consist, for example, of aluminum profiles, thick aluminum plates, many individually manufactured angle brackets, and sometimes hundreds of screws, new implementations using 3D printing allow for a significant reduction in components, parts, and overall weight. Various 3D printing technologies can be applied in this process. As a result, delivery times are drastically reduced, while costs and energy consumption are also lowered. By reducing weight, smaller robots can be deployed, cycle times can be shortened, and CO_2 emissions can be significantly decreased.

In ongoing projects lightweight grippers already achieved 50% energy and 20% cycle time reduction.



In this project, we complete an already initiated lightweight design of a robot end effector for handling sheet metal parts. 3D printing enables the realization of maximum lightweight solutions even for complex parts, with the aid of topology optimization and infill structures in the design. Various materials and 3D printing technologies are applied to realize clamping mechanisms, structural node elements, and adjustment devices as efficiently and lightly as possible. 3D scan technology is incorporated into the development process for reverse engineering and quality inspection. Finally, the designed and printed parts are assembled into a complete physical end effector and subjected to load

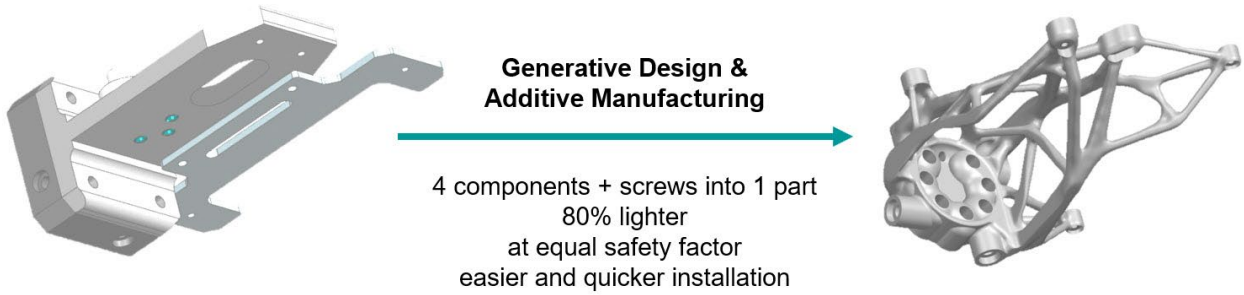
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Module A

Designing of a part and preparation for Selective Laser Melting (SLM) technology

Abstract

Additive manufacturing provides organizations with the opportunity to rethink and redesign components and assemblies to reduce the number of components in the assembly and so reducing labour time, production and lead times and overall part cost.

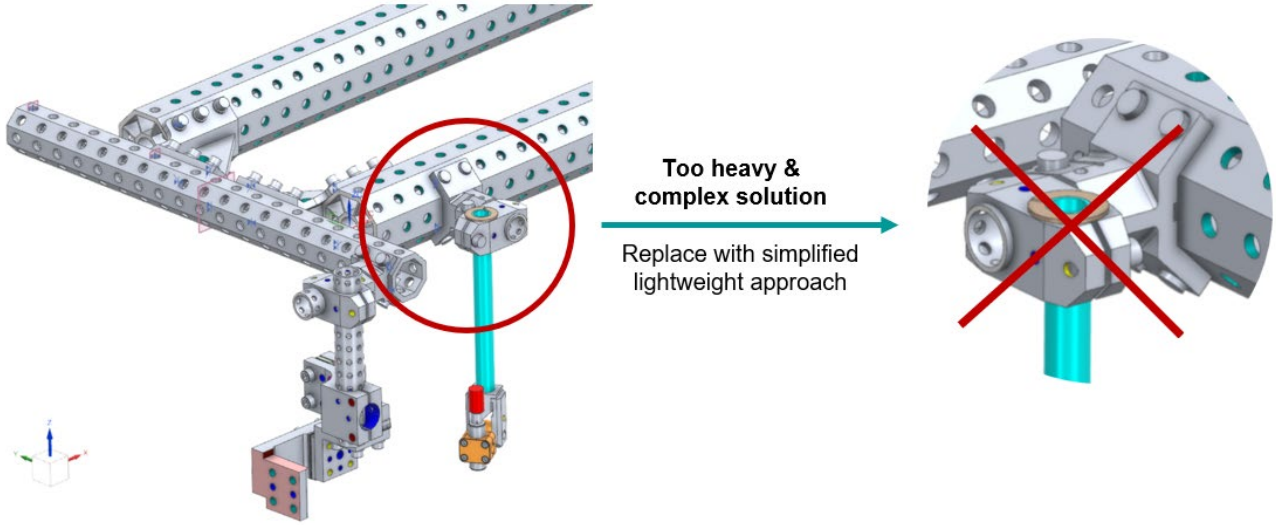


Instructions to the Competitor

Competitor will get: STEP file with a sensor assembly on a mounting rod

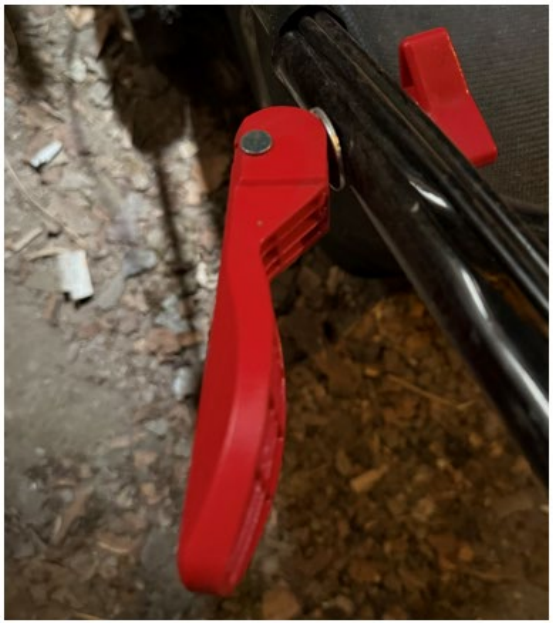
Task

In a classical robot end-effector assembly, sensors are frequently mounted on mounting rods to achieve proper alignment in terms of height and direction. To date, repositioning or fine-tuning has been laborious, as the rod is permanently fastened to the gripper structure. To ensure maximum flexibility for factory workers, we are redesigning this to incorporate a modular quick-release clamping mechanism.



Here we have two (2) examples of quick-release clamping mechanism as they have already been used successfully in everyday objects for a long time:

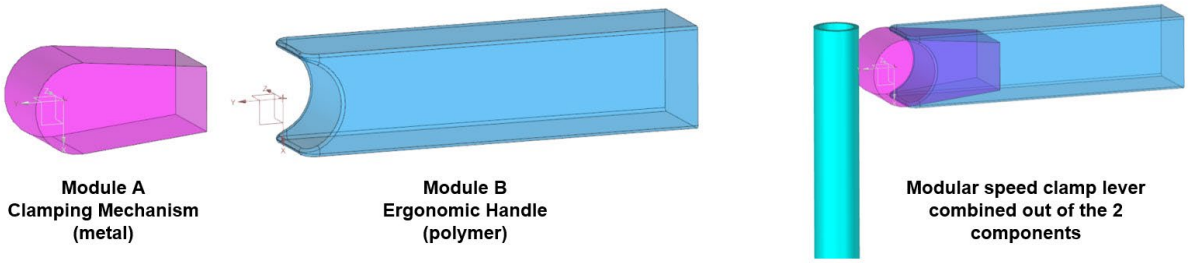
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Your design must include the following:

- Modular speed clamp lever combined out of two (2) components, that will be separately designed in Module A and B

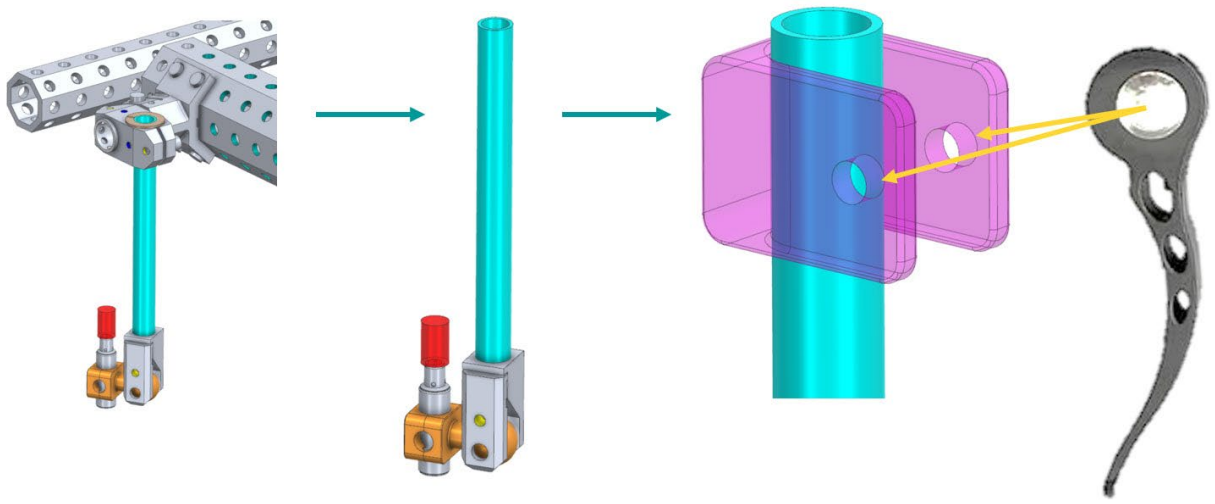


Module A
Clamping Mechanism
(metal)

Module B
Ergonomic Handle
(polymer)

Modular speed clamp lever combined out of the 2 components

- Module A: Quick-release clamping mechanism made of metal that will hold the tube
- (Next exercise Module B: Ergonomic handle element that must be connected to the clamping mechanism made of polymer)
- Clamping mechanism component designed for Selective Laser Melting (SLM) technology
- Maximum lightweight design
- Minimum number of parts
- Minimize needed print supports
- Maximum dimensions to fit into a given area on the build plate
- Solid connection between clamping mechanism (Module A) and handle element (Module B), designed to withstand the applied loads, must be integrated.
- The following standard elements are available for the assembly operations: M4 nuts, washers and screws with three (3) available lengths of 20mm, 30mm and 40mm.



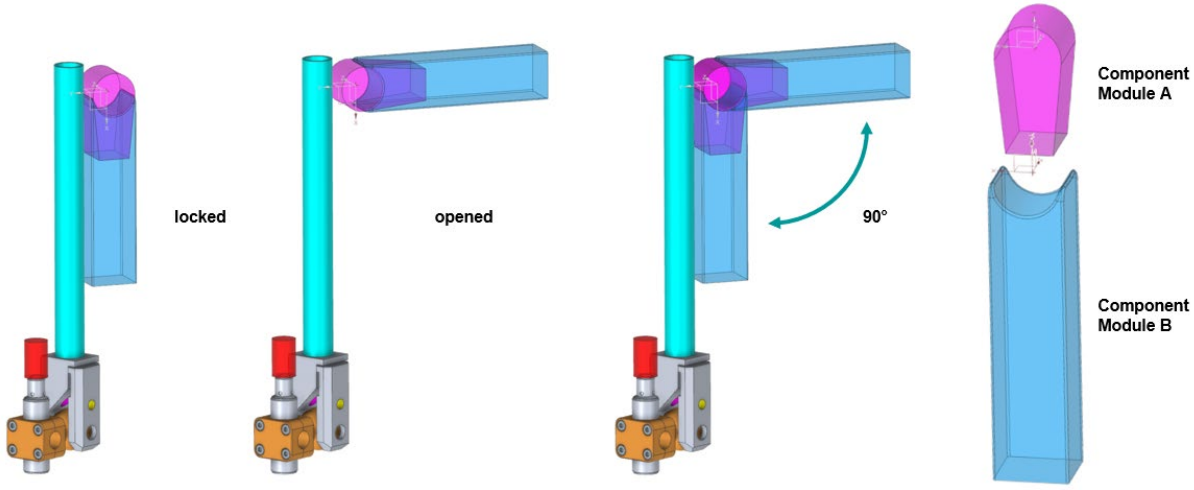
Design of speed clamp to build using SLM technology

1. Set up a design project/folder and save it as instructed by the Competition Manager "WSC2026_TP57_Module A"
2. Create a new design and save it as "WSC2026_TP57_Module_A_*(Competitor_number)*"
3. Design the clamping mechanism component taking into account the following:

   (a) The goal is to find a solution that requires a minimal number of parts.
   (b) Target is to develop a minimised weight solution.
   (c) Maximum dimensions: The result has to fit into an area of 50mm (X) x 50mm (Y) x 60mm (Z) on the build plate (Already oriented for needed print quality and functionality including supports – all inside this box dimensions)
   (d) Quick-release clamping mechanism must be closed/clamping when it is pulled down. The open position is 90° up (horizontal position).
   (e) Solid connection between clamping mechanism (Module A) and handle element (Module B), designed to withstand the applied loads, must be integrated. Come up with a solution that you would like to apply here. It should be simple in terms of implementation, assembly, and operation, and contain as few parts as possible.
   (f) We assume a force of 100N at the end of the lever plus a safety factor of 1.5, see force vector in the STEP file. Document and your assumed load cases and constraints. Justify your answer.
   (g) The connection must be planned and integrated in the solution/geometry of the clamping mechanism in this module. During Module B you must design and integrate the fitting counterpart for the connection into the result geometry of Module B.
   (h) The printed part to have serial number Debossed on the part "CN_*(Anonymous code given to Competitor)*".
   (i) The design assembly must take into account the capabilities and limitations of the DMG Mori LASERTEC 30 SLM technology (including size restrictions, minimizing the possible number of supports and the possible postprocessing costs).

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(j) The part needs to be orientated to fit on a 50mm x 50mm build plate. Maximum hight: 60mm.



4. Set up the slicing file for the part and setting the printer to DMG Mori LASERTEC 30 SLM, determine the best orientation use the following slicer settings that have been provided by DMG Mori:

   (a) Material – stainless steel 1.4404
   (b) Export the file for sending to DMG Mori.

   If you are using Siemens NX: prepare the printing setup. Choose the right orientation and prepare the support structure. Export the prt-file without slicing.
   If you are using Autodesk Fusion360: Export your design into a STEP file and prepare the print in NX as described above.
5. Save your file to your design folder "WSC2026_TP57_Module A".

In following exercises your designed speed clamp will be integrated into a complete gripper assembly, but for now, we are done.

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Module B

Jig design and building by Fused Filament Fabrication (FFF) technology

Abstract

Custom making of tooling, jigs, and fixtures is a very common application for FFF technology, utilized by large organizations as well as small and medium-sized enterprises. Beyond these applications, FFF also enables the production of custom-designed handles and gripping elements, which serve as essential tools for our operations. This capability allows organizations to incorporate error-proofing design principles—ensuring intuitive, mistake-proof workflows with custom ergonomics—such as during product assembly, machine maintenance, and gripper changeovers. This approach significantly accelerates equipment reconfiguration and enhances operational flexibility across all organizational sizes.



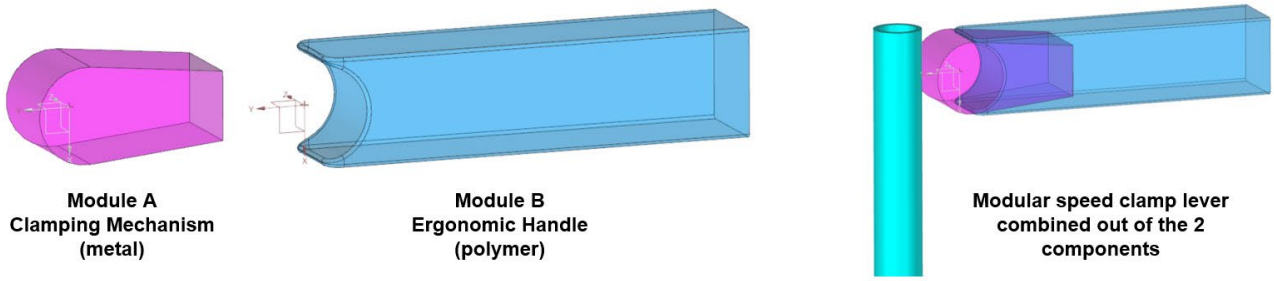
Three (3) examples of polymer gripper and jigs, which successfully replaced metal solutions

Instructions to the Competitor

Competitor will get/have: STEP file with a sensor assembly on a mounting rod plus resulting component from Module A

Task

To ensure safe and ergonomic operation of the speed clamp component, we need a custom-designed handle that is lightweight and provides optimal grip comfort. The handle must connect securely and easily connectable to the pink speed clamp element from Module A and is shown symbolically in the image as the blue component.



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Your design must include the following:

- Ergonomic handle element of modular speed clamp lever, that must be connected to the clamping mechanism from Module A
- Ergonomic handle element made of polymer. See examples and find your own design solution.





- Designed for Fused Filament Fabrication (FFF) technology
- Maximum lightweight design
- Solid connection between clamping mechanism (Module A) and handle element (Module B), designed to withstand the applied loads, must be integrated.

Design of speed clamp to build using SLM technology

1. Set up a design project/folder and save it as instructed by the Competition Manager "WSC2026_TP57_Module B"
2. Create a new design and save it as "WSC2026_TP57_Module_B_*(Competitor_number)*"
3. Design the ergonomic handle element taking into account the following:

   (a) it should consist of the minimum possible number of parts.
   (b) We need a maximum lightweight design solution in the end.
   (c) Maximum dimensions: 50mm x 50mm x 140mm (Lenght)
   (d) Solid connection between clamping mechanism (Module A) and handle element (Module B), designed to withstand the applied loads, must be integrated. Come up with a solution that you would like to apply here. It should be simple in terms of implementation, assembly, and operation, and contain as few parts as possible.
   (e) The following standard elements are available for the assembly operations: M4 nuts, washers and screws with three (3) available lengths of 20mm, 30mm and 40mm
   (f) We assume a force of 100N at the end of the lever plus a safety factor of 1.5, see force vector in the STEP file. Document and your assumed load cases and constraints. Justify your answer.
   (g) The counterpart of the connection was already planned and integrated in the solution/geometry of the quick-release clamping mechanism in Module A. During this module you must design and integrate the fitting counterpart for the connection into the result geometry.
   (h) The printed part to have serial number Debossed on the part "CN_*(Competitor number)*".
   (i) The design assembly must take into account the capabilities and limitations of the FFF technology (including size restrictions, minimizing the possible number of supports and the possible postprocessing costs).
   (j) The part needs to be orientated to fit on your FFF printer.

4. Save your file to your design folder "WSC2026_TP57_Module B".
5. Export the part as a .stl file, selecting the appropriate quality settings to ensure that the Polygonization of the model is not seen as lines on the printed part.
6. Import the part into the slicing software.
7. Select the appropriate material in the slicing software for an ergonomic handle from the material provided.

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8. Add appropriate support to the part if required.
9. Select the most appropriate slicing settings and produce the slice file for printing, the functionality of the ergonomic handle must be guaranteed. You must ensure that the print is completed in five (5) hours or under.
10. Calibrate and Set up the FDM printer for printing with the material selected in the slicer.
11. Print the part file once.
12. Remove from the print bed.
13. Post process the printed part if required.

Module C

3D Scanning and reverse engineering for additive manufacturing using Topology Optimisation and Generative Design

Abstract

Traditionally, robot grippers and end-effectors are assembled from heavy metal plates and standard profiles following a modular construction principle. The combination of standard and custom-machined components typically results in designs exceeding 100 kg in weight, necessitating heavy, energy-intensive industrial robots. By redesigning with additive manufacturing and topology optimization, lightweight solutions can be achieved that—when combined with carbon fibre tubes—maintain large spans while enabling the use of energy-efficient cobots. This approach reduces energy consumption, CO_2 emissions, and spatial footprint. Additionally, lower weight decreases cycle times, and 3D printing dramatically shortens delivery times.







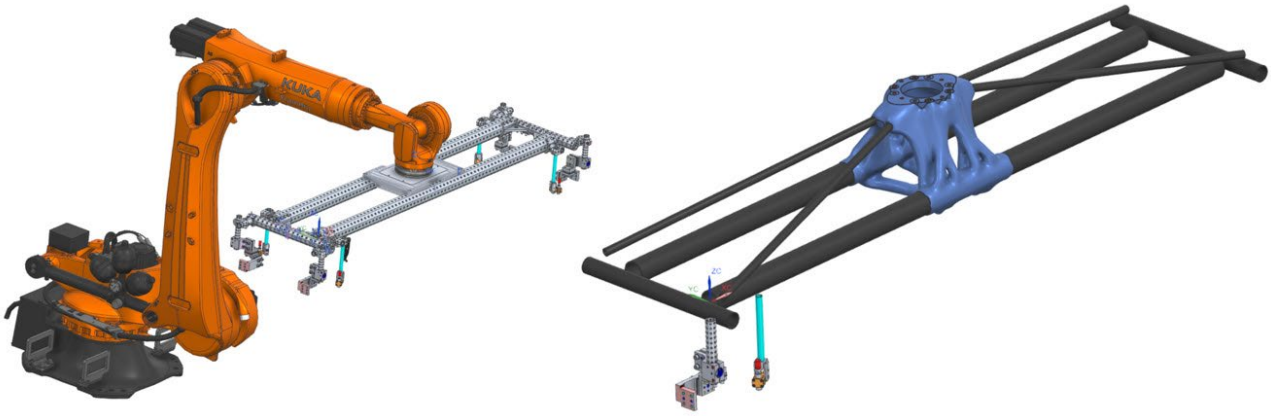
Instructions to the Competitor

Competitor will get: Uncomplete robot end effector assembly to be scanned and prepared for reverse engineering and design in context. Start part with axis system and force information.

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Task

An innovation project within our company developed a lightweight gripper replacement for sheet metal handling applications with integrated sensors, implementing a modular design approach featuring carbon fibre tubes and 3D-printed node elements. Due to organizational restructuring, the project was temporarily suspended in an incomplete state. We now plan to finalize the lightweight gripper by topologically optimizing the missing junction elements and manufacturing them via FFF technology. Since the original CAD data is unavailable, the existing prototype will be scanned to establish the design baseline.



Your design must include the following:

- Junction element to connect the three (3) carbon fibre tubes.
- Based on the 3D scanned geometry of the tubes.
- Designed for Fused Filament Fabrication (FFF) technology.
- Maximum lightweight design by using topology optimization.
- At this stage we assume that a load of 50N will be applied on the tube with medium thickness in X, Y and Z. But not at the same time. It will occur in three (3) separate load cases. You will find detailed position in the given start model.
- Safety factor is 12 for the emergency stop of the robot.
- A solid connection between the connecting node element and the carbon tubes, designed to withstand the applied loads, must be integrated. Come up with a solution that you would like to apply here. It should be simple in terms of implementation, assembly, and operation, and contain as few parts as possible. Perhaps there is also some inspiration to be drawn from Modules A, B, and D.
- The following standard elements are available for the assembly operations: M4 nuts, washers and screws with three (3) available lengths of 20mm, 30mm and 40mm.
- The assembly must be mounted successfully in the end. The ability to assemble the component into the end effector system must be guaranteed.

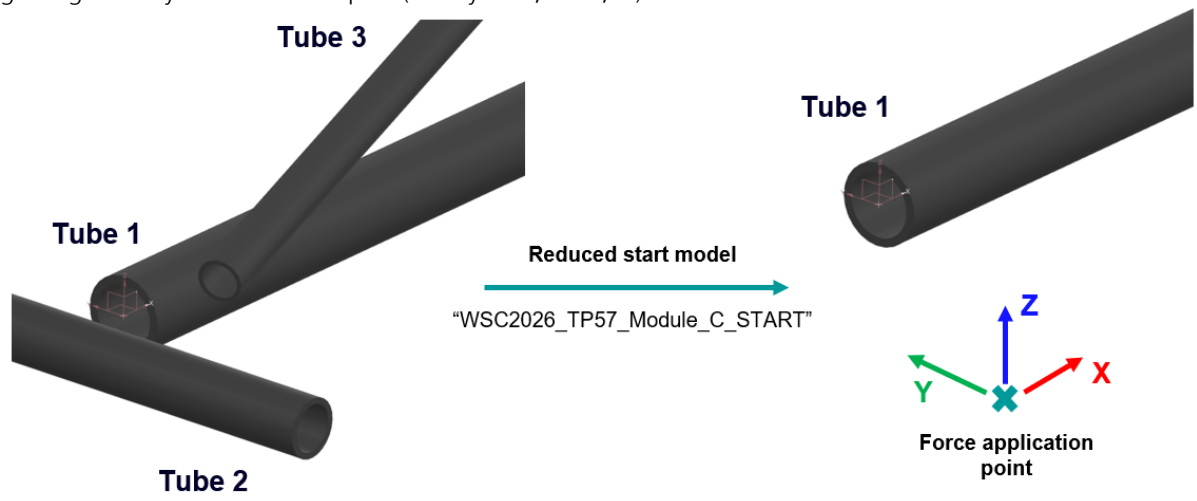


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Scan end effector assembly and design the junction element to build using FFF technology

1. As a special task, self-organize and coordinate amongst your groups to determine the order in which each group gets access to the object to be scanned – teamwork and fair play are key! Every group will have 20 minutes to scan the given end effector elements.
2. Groups waiting for their turn to scan can already start working on Module D.
3. Set up a design project/folder and save it as instructed by the Competition Manager "WSC2026_TP57_Module C"
4. Open the given start part "WSC2026_TP57_Module_C_START" and save it as "WSC2026_TP57_Module_C_*(Competitor_number)*"
5. Design the junction element taking into account the following:

   (a) Import and position your scanned geometry in the prepared part. For correct orientation please use the given geometry from the start part (axis system, tube,…)



   (b) It should consist of the minimum possible number of parts.
   (c) A solid connection between the connecting node element and the carbon tubes, designed to withstand the applied loads, must be integrated. Come up with a solution that you would like to apply here. It should be simple in terms of implementation, assembly, and operation, and contain as few parts as possible. Perhaps there is also some inspiration to be drawn from Modules A, B, and D.
   (d) Use topology optimised to minimise weight.
   (e) The printed part to have serial number Debossed on the part "CN_*(Competitor number)*".
   (f) The design assembly must take into account the capabilities and limitations of the FFF technology (including size restrictions, minimizing the possible number of supports and the possible postprocessing costs).
   (g) The part needs to be orientated to fit on your FFF printer.
   (h) Do not start the print now and wait for later modifications.

Save your file to your design folder "WSC2026_TP57_Module C".

In this skill competition, we are creating a cohesive assembly. This node is a central part of it and will be further completed later to ensure the integration of additional components into the system. The work on this component will be continued in Module E.

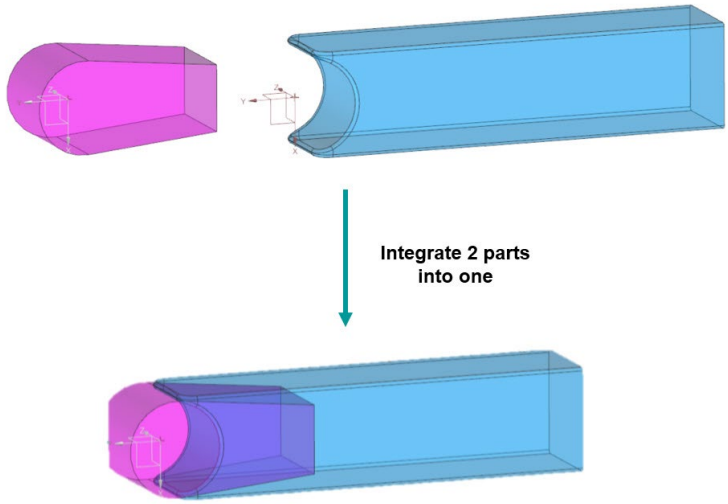
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Module D

Design modification for FFF/DLP-Design and print preparation

Abstract

It is common for an initial design to be reconsidered and revised. There can be various reasons and requirements for this. In the upcoming modules, we will need the speed clamp solution several more times, but we no longer have the time, budget or the possibility to have new metal parts printed. Thanks to the flexibility of additive manufacturing, we will re-engineer our current speed clamp into one (1) unified low-budget polymer part. Let us further simplify the existing design.



Instructions to the Competitor

Competitor will get: Geometry and setup from results and input from Module A and B.

Task

Redesign your handle for the quick release. Reuse your speed clamp design and change it to a one (1) part to be printed with FFF or DLP technology.

You are free to select the printing technology (FFF/DLP) you prefer for this challenge. Select the best fitting technology.

Your design must include the following:

- Merged speed clamp lever combined out of 2 components, designed in Module A and B.
- One (1) single combined part
- Keep or improve the clamping mechanism and the ergonomic handle solution from Module A and B
- The component must withstand the prevailing load cases and be designed accordingly
- Designed for Fused Filament Fabrication (FFF) or DLP technology
- Maximum lightweight design

Redesign your handle for the quick release for FFF/DLP technology

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1. Set up a design project/folder and save it as instructed by the Competition Manager "WSC2026_TP57_Module D"
2. Create a new design and save it as "WSC2026_TP57_Module_D_*(Competitor_number)*"
3. Design the merged handle for the quick release taking into account the following:

   (a) it should consist of only one (1) part.
   (b) The component must withstand the prevailing load cases and be designed accordingly.
   (c) We need a maximum lightweight design solution in the end.
   (d) The printed part to have serial number Debossed on the part "CN_*(Competitor number)*".
   (e) The design assembly must take into account the capabilities and limitations of the FFF/DLP technology (including size restrictions, minimizing the possible number of supports and the possible postprocessing costs).
   (f) The part needs to be orientated to fit on your FFF/DLP printer.

4. Save your file to your design folder "WSC2026_TP57_Module D".
5. Export the part as a .stl file, selecting the appropriate quality settings to ensure that the Polygonization of the model is not seen as lines on the printed part.
6. Import the part into the slicing software.
7. Select the appropriate material in the slicing software for a speed clamp from the material provided.
8. Add appropriate support to the part if required.
9. Select the most appropriate slicing settings and produce the slice file for printing, the functionality of the speed clamp and ergonomic handle must be guaranteed. – you must ensure that the print is completed in six (6) hours or under.
10. Calibrate and Set up the FFF/DLP printer for printing with the material selected in the slicer.
11. Print your new combined speed clamp twice. We need two (2) of them later on.
12. Remove from the print bed.
13. Post process the printed parts if required.

There is the possibility of testing simplified and quickly printed prototypes of the speed clamp mechanism at a small test stand during the design phase.

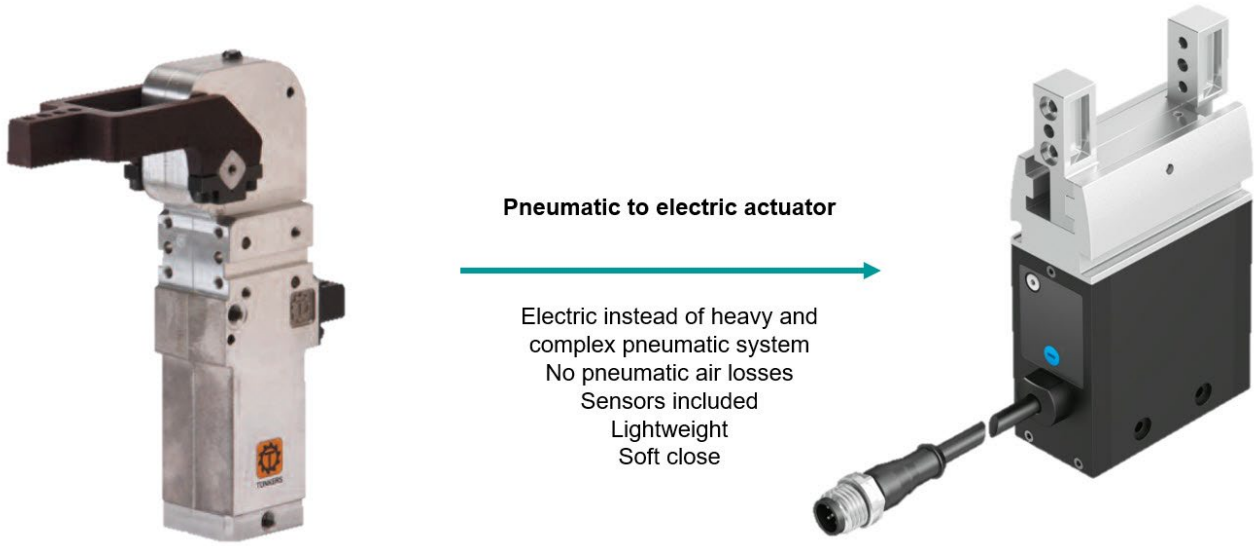
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Module E

Reverse Engineering and Design Change (DLP and FFF)

Abstract

The junction component from Module C will now be expanded with additional functions. So far, it holds the three (3) carbon fibre tubes together and in position. Now, an actuator and the sensor are to be attached and integrated using adjustable mounts. Additionally design an adjustable actuator holder/mount in XYZ directions and integrate it into the node element from Module C.



Instructions to the Competitor

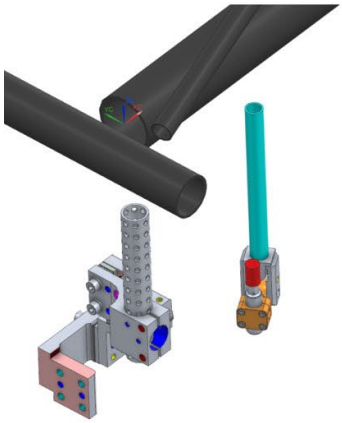
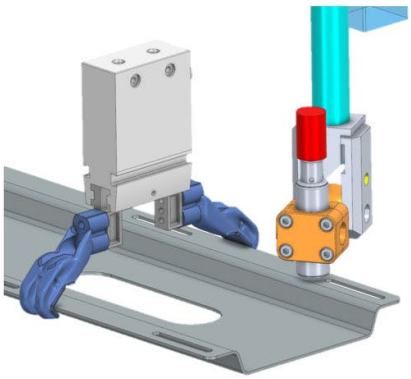
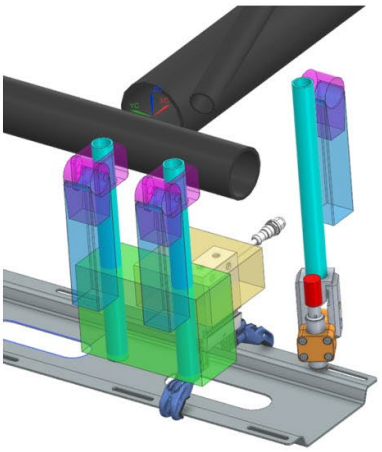
Competitor will get: Uncomplete robot end effector assembly for positioning and measurements. Result components from Modules A, B, C and D. Start part with position of actuator with fingers, sensor and sheet metal part to be caried.

Task

The change the actuator from pneumatic to electric. We also change the mount of the actuator and include XYZ calibration. Reuse your speed clamp design from Module D. The components of the actuator mount including XYZ calibration will be printed with Digital Light Printing (DLP) technology.

Modify and print the tube connector joint with three (3) speed clamp attachments for the actuator (two (2) tubes) and the sensor (one (1) tube). The connector joint will be printed with Fused Filament Fabrication (FFF) technology.

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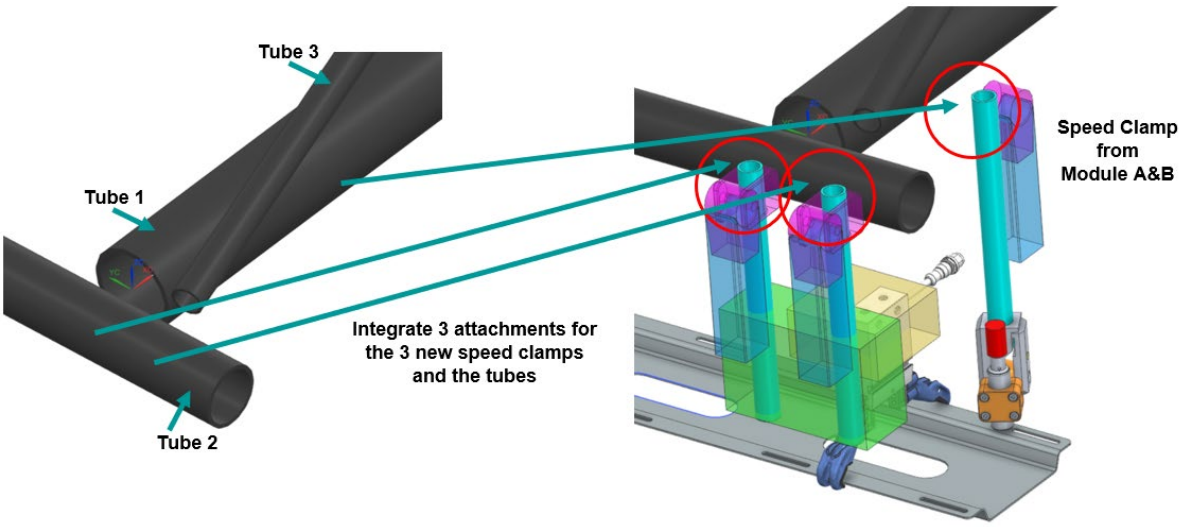
Your design must include the following:

- Junction element to connect the three (3) big carbon fibre tubes of the robot end effector
- A solid connection between the connecting node element and the carbon tubes, designed to withstand the applied loads, must be integrated.
- Take the given and prevailing load cases into account during the design process. The occurring load will be applied in X, Y and Z direction. But not at the same time. It will occur in three (3) separate load cases. Force is 50N and the safety factor is 12, for the emergency stop of the robot.
- Include the three (3) needed connectors for the three (3) speed clamps with the smaller tubes.
- Keep the target Maximum lightweight design for the junction component and use topology optimization.
- Junction element designed for Fused Filament Fabrication (FFF) technology
- Design of additional components for X and Y calibration of the actuator.
- Calibration adjustment Range of 100mm in X and Y direction. Symmetrical from the middle.
- Follow a lightweight design approach for the mount.
- Actuator mount components for XYZ calibration designed for DLP technology.
- The assembly must be mounted successfully in the end. The ability to assemble the component into the end effector system must be guaranteed.
- The following standard elements are available for the assembly operations: M4 nuts, washers and screws with three (3) available lengths of 20mm, 30mm and 40mm

Design the junction element to build using FFF technology and the actuator mount and XYZ calibration to build using DLP technology

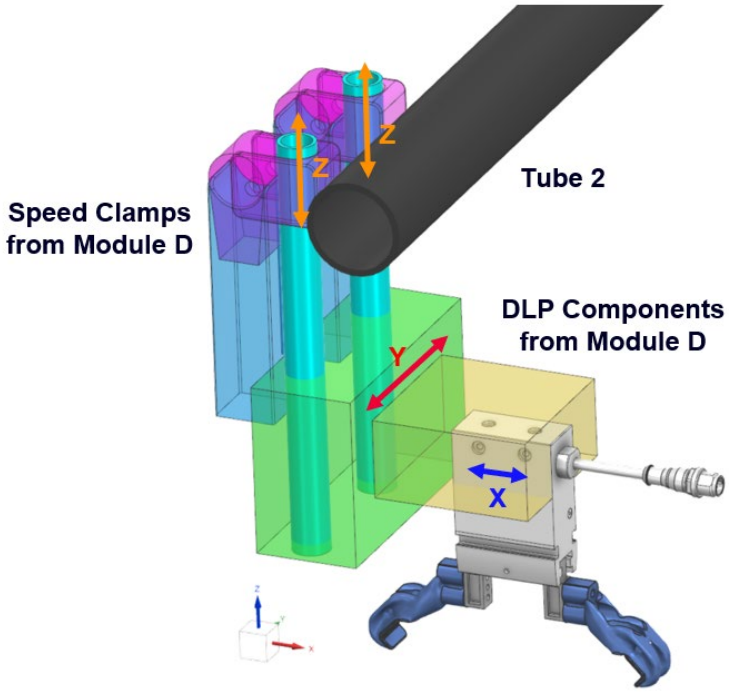
1. Set up a design project/folder and save it as instructed by the Competition Manager "WSC2026_TP57_Module E"
2. Open start part "WSC2026_TP57_Module_E _START" and save it as "WSC2026_TP57_Module_E_START_(Competitor_number)"
3. Create a new design and save it as "WSC2026_TP57_Module_E_Junction_*(Competitor_number)*"
4. Position your existing junction node from Module C using the given start part and the contained geometries. There you will find for positioning tube 1 from the end effector and the three (3) mounting tubes for the actuator and sensor.

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5. Design the junction element taking into account the following:
   (a) Modified connector joint must include the three (3) needed connectors for the three (3) speed clamps for Z adjustment of the three (3) smaller tubes (actuator: two (2) tubes; sensor: one (1) tube)
   (b) Keep or improve functionality from Module C.
   (c) It should consist of the minimum possible number of parts.
   (d) Maximum lightweight design by using topology optimization.
   (e) A solid connection between the connecting node element and the carbon tubes, designed to withstand the applied loads, must be integrated. Come up with a solution that you would like to apply here. It should be simple in terms of implementation, assembly, and operation, and contain as few parts as possible. Perhaps there is also some inspiration to be drawn from Modules A, B, and D.
   (f) Take the given and prevailing load cases into account during the design process. The safety factor is 12, for the emergency stop of the robot.
   (g) The printed part to have serial number Debossed on the part "CN_*(Competitor number)*".
   (h) The design must take into account the capabilities and limitations of the FFF technology (including size restrictions, minimizing the possible number of supports and the possible postprocessing costs).
   (i) The part needs to be orientated to fit on your FFF printer.
6. Design the actuator mount components for X and Y calibration.
7. Create new designs and save it as "WSC2026_TP57_Module_E_Calibration_X_(Competitor_number)" and "WSC2026_TP57_Module_E_Calibration_Y_(Competitor_number)"
8. Design the actuator mount components, taking into account the following:

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(a) It should consist of the minimum possible number of parts and should be easy to use.
(b) Create the green and yellow parts, symbolized by the boxes for Y and X adjustment
(c) The actuator must be fixed with two (2) screws on one (1) of the three (3) designated surfaces.
(d) Calibration adjustment Range of 100mm in X and Y direction (+-50mm in X and Y). The set position must be able to be fixed in each axis. Ensure that a minimal deformation of your assembly under load is given.
(e) Follow a lightweight design approach for the mount.
(f) A solid connection between the calibration components, the tubes and the actuator, designed to withstand the applied loads, must be assured and integrated. Come up with a solution that you would like to apply here. It should be simple in terms of implementation, assembly, and operation, and contain as few parts as possible.
(g) The printed part to have serial number Debossed on the part "CN_*(Competitor number)*".
(h) The design assembly must take into account the capabilities and limitations of the DLP technology (including size restrictions, minimizing the possible number of supports and the possible postprocessing costs).
(i) The parts needs to be orientated to fit on your DLP printer.

9. Save your files to your design folder "WSC2026_TP57_Module E".
10. Export the parts as a .stl file, selecting the appropriate quality settings to ensure that the Polygonization of the model is not seen as lines on the printed parts.
11. Import the parts into the correct slicing software (FFF and DLP).
12. Select the appropriate material in the slicing software for the components from the material provided.
13. Add appropriate support to the parts if required.
14. Select the most appropriate slicing settings and produce the slice files for printing, the functionality of the components must be guaranteed. – you must ensure that the prints are completed in eight (8) hours or under.
15. Calibrate and Set up the FDM/DLP printer for printing with the materials selected in the slicer.
16. Print your new designed components.
17. Remove from the print bed.
18. Post process the printed parts if required.

Module F

3D-scanning and postprocessing

Abstract

After the successful printing of the components, the exciting question is always whether all geometries and surfaces are present in the printed part with the required quality. It also becomes apparent at this stage whether all support structures can be removed easily — or at all — how much post-processing is still necessary, and whether the surfaces beneath the supports have a sufficient quality.
Once the components have been cleanly separated from the support structures, they must also fit within their assemblies and fulfill their function in accordance with their specifications. A digital pre-examination of the geometry is offered by the 3D scanning process. The scan of the printed parts can be overlaid and compared with the designed geometry in the CAD system. Are there any deformations? Are there deviations in the geometries, and if so, how significant are they? All of this is what we will find out in this module.





Instructions to the Competitor

Competitor will get: Own printed junction component from Module E.

Task

Quality Check junction element – Post process and scan your printed junction component from Module E (FFF).

Your post process and scan tasks must include the following:

- Component successfully designed for Fused Filament Fabrication (FFF) technology?
- Are all supports removable and do the surfaces beneath them have sufficient quality?
- Scan and digitize the printed component.
- The scanned part must be “waterproof”.

Postprocessing and scan of the printed junction element from Module E.

1. Set up a design project/folder and save it as instructed by the Competition Manager “WSC2026_TP57_Module F”
2. Create a new design and save it as “WSC2026_TP57_Module_F_*(Competitor_number)*”

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3. Do the postprocessing for the printed part:

   (a) Remove all supports from the component and clean up the surfaces if necessary.
   (b) Are all supports easily removable? Please document your assessment.
   (c) What is the overall condition of the component and was the print successful? Please document your assessment.
   (d) What is the quality of the surfaces? Please document your assessment.
   (e) How do you assess the functionality of the component prior to scanning? Please document your assessment.
   (f) Is the serial number debossed on the part "CN_*(Competitor number)*" readable?

4. 3D-Scan the printed junction element from Module E
5. Prepare the scan data to be exported to STL format for later comparison with the original geometry in the accessment.

Save your file to your design folder "WSC2026_TP57_Module F".

Are there any deviations between the printed component and the original designed in the CAD tool? Your part will be analysed after this exercise in the assessment.

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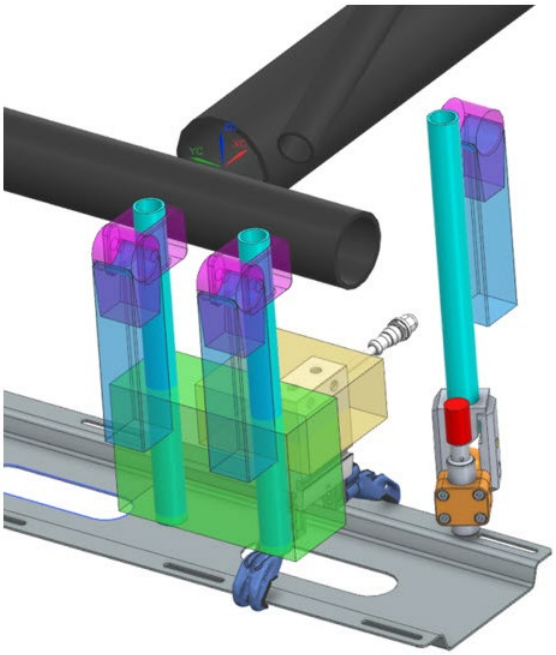
Module G

Final assembly of the robot end-effector assembly with your components

Finally, the printed component is transferred to its intended purpose and installed and integrated into the assembly. In doing so, important properties must be present and must not have been lost during the printing process. Does the component fit and can it be integrated and installed into the assembly as planned? Is the installation even feasible? Are the intended functions guaranteed, such as the clamping devices and adjustment options? Let us find out and assemble our robot end effector assembly using the newly printed components from the various 3D printing technologies and calibrate it.

Abstract

After all components have been designed and printed, it´s time to assemble our new lightweight robot end-effector. Adjust it, that you can grip the sheet metal part and the sensor is in place. Use all your created parts and solutions for the assembly and bring everything into the required position by utilizing your XYZ adjustment and clamping solutions.



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Instructions to the Competitor

Competitor will get: Printed components from last modules and given end effector components.

Task

Assembly of the robot end-effector with your components.

Your assembly must include the following:

- All your printed components
- A solid connection between junction element and carbon fibre tubes, designed to withstand the applied loads
- A solid connection between speed clamps and carbon fibre tubes, designed to withstand the applied loads
- A solid connection between actuator, X an Y adjustment components and carbon fibre tubes, designed to withstand the applied loads
- The Sensor must be adjustable in Z direction and can be rotated around the carbon fibre tube axis when the speed clamp is in "Open" position.
- The Actuator must be adjustable in X,Y and Z direction.
- Bring everything into the needed position that the end effector can start its work and grab and handle the sheet metal part correctly.

Assemble the complete end effector assembly with your own and given components

1. Assemble the end effector assembly with the available components
2. Use your XYZ adjustments to bring everything into the needed position that the end effector can start its work and grab and handle the sheet metal part correctly and the sensor is in the right place:

   (a) The fingers mounted to the actuator should grab the sheet metal part. The sheet metal part is placed symmetrically between the fingers.
   (b) The sensor must be paced in a distance of 2mm above the sheet metal part to give feedback, if a sheet metal part is in place.

3. Test your assembly under load.

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