Design of a Compliant Gripper for gripping a flexible body

Work objectives

The design of grippers for industrial robots remains a complex task. There is no "universal" gripper and a specific design is elaborated for each given type of robotic task, defined by several contact points during grasping, contact geometry, ...

One design approach today considered is to use compliant grippers. The grasping motion is then obtained by using on purpose the elasticity of a single part that will deform under a mechanical action. Pneumatic energy is often considered, as it is widely available. Our goal is here to design, manufacture and make initial testing of a monolithic compliant gripper, following a design approach for instance developed by the Monolitix company (see the RG16 gripper datasheet, and the picture above).

As an actuation source, we consider the small stroke cylinder Festo_ADVC-12-10-I-P (see specifications in appendix). Additive manufacturing is here used to exploit the freedom of shape available with the process to maximize the gripper stroke. We consider the Fused Deposition Modeling (FDM) process. PLA material is being used (datasheet given in appendix), using an Ultimaker S5 3D printer (datasheet given in appendix).

The gripper stroke must be in the direction perpendicular to the cylinder axis. The structure of the gripper must fit in a 70x70x40 mm volume. Your mission is to grab a soft spherical object with a diameter of 20 mm. The softness of the sphere will have to be specifically managed. The design can be inspired by solutions described in the provided atlas of grippers and the description of various designs of compliant rotational joints. An introduction to FEA analysis to perform numerical simulation of part deformations is also provided.

Provided elements

Creo CAD software is available for gripper design. An Ultimaker S5 printer will be used for production of your prototype.

Work sequence

Work will be achieved in 2 steps:
Step 1 (9 hours) – Brainstorming and gripper design
Step 2 (1.5 hour) –Testing using Festo components

Additional comments

You will produce a 5-page report as a synthesis of your work. This report will describe the reasoning to obtain the gripper design, justifications of main design choices, the results and your critical review of the use of additive manufacturing.