3D printed passive end-effector for industrial collaborative manipulators

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The work focuses on the design and prototyping of a novel end-effector for an collaborative robotic arm allowing to grabbing and dragging industrial packages without lifting them [1]. The proposed solution consists of a passive 3D-printed end-effector which its mechanical components were manufactured through a fused filament fabrication (FFF) Markforged 3D printing machine from the carbon fiber reinforced Onyx material [2], which has the peculiar feature of high stiffness and temperature resistance. This allows to fabricate low cost parts with high surface finish, while ensuring accurate couplings between the mechanical components. Specifically, the proposed end-effector includes three main parts. First, a thin blade, which has the main function of separating boxes that are close to each other. Second, a rocker arm - rod mechanism allows to move an opposable bracket in order to grab the correspondent package. This is proportionally and passively actuated by the touching pressure between the package, during its grip, and a pedal (third part), which is composed of a paddle and three flexural springs to counteract the pushing force. This pedal is fully manufactured with the main body of the gripper. Moreover, we implemented a *Simscape* dynamic model that is able to reproduce the same functionality of the end-effector during standard operations. The work shows how to design, develop and validate a new low cost, 3D-printed, passive end-effector for industrial manipulators.

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