Design and Characterization of a Double Stepped Beam for Const Force Mechanism

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Abstract

Uncertain contact force between a precise robotic end-effector and a fragile target may cause damage to the robot and the target. Force feedback control techniques for regulating the contact force are commonly adopted to avoid the additional cost generated by the potentially harmful contact force. The force control methods can be robust, but their application is limited by the incurred high costs, equipment complexity, and technical issues related to integration of the control system. A possible alternative is the force regulation capability provided by compliant constant force mechanisms (CCFMs). With few movable components, the use of compliant mechanisms results in reduced wear, reduced need for lubrication, and an increased mechanism precision [1].

CCFMs presented so far have certain limitations of small displacement range of constant force output, variation in the constant force level and complex structures [2]. Damage-free manipulation in cell engineering and robotics requires a large operational range of constant force and stable output force [3]. In this investigation, a CCFM based on an asymmetrical stepped beam is developed. The CCFM has a compact structure and a stable level of constant force. An optimization process is developed for design of the CCFM with prescribed operational range and constant force level. Experiments will be carried out to verify the effectiveness of the developed CCFM.

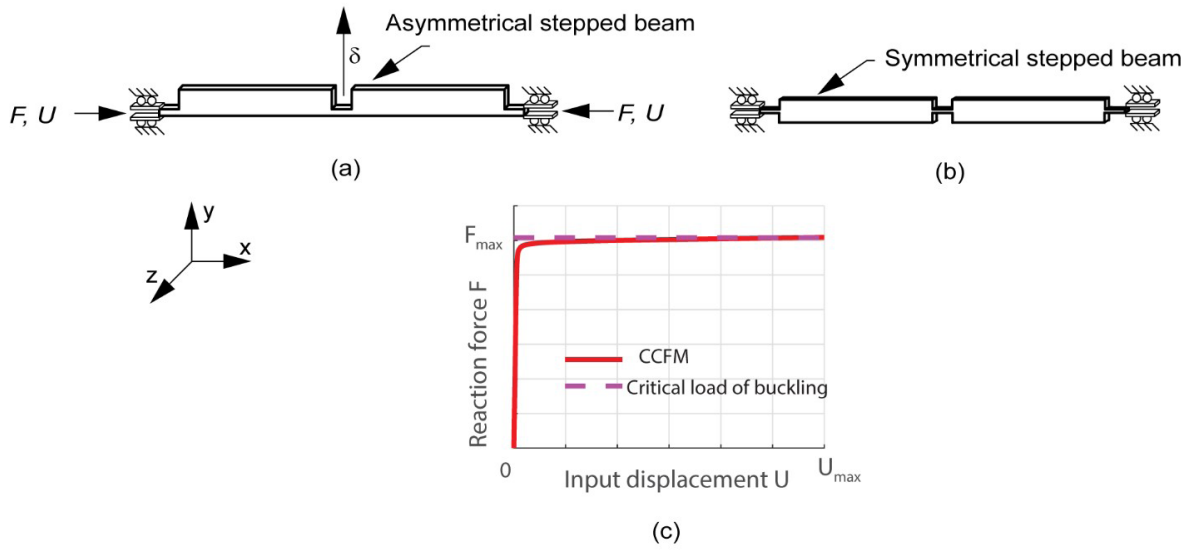

Figure 1. (a) Schematic of an asymmetrical stepped beam. (b) Schematic of a symmetrical beam. (c) A typical force-displacement curve of the asymmetrical stepped beam