

## **Low-Cost Open Architecture Mechatronics Platform for System Dynamics and Control Systems Experiments**

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Traditional system dynamics and control systems learning platforms are costly, non-portable, and require substantial laboratory space. Consequently, these traditional systems must be shared amongst large groups of students, resulting in students getting less than adequate individual hands-on time. Low-cost take-home kits offer an alternative way to deliver commensurate learning experiences found with expensive platforms but at an affordable price bracket. This paper presents the design and educational function of a sub-one-hundred-dollar, portable, and multidisciplinary pendulum platform. This low-cost experimental apparatus provides an opportunity for students to apply conceptual knowledge without the restriction of geographic location. The learning outcomes are identical to their expensive traditional counterparts, and concepts covered include: system identification, modeling, simulation, s-domain analysis, frequency domain analysis, and feedback control principles. Setting this low-cost experimental system apart from others is the open architecture. The hardware is comprised of common off-the-shelf components and 3D printed parts for which the design files are publicly available. Computer-assisted data acquisition for the platform is made possible via MATLAB/Simulink, LabView, or Arduino and allows for sufficiently fast sample rates with no proprietary software or plugins. This offers students the opportunity to become proficient with industry-standard software packages. This paper describes the design and educational outcomes of a sub-\$100 take-home mechatronics kit designed to equal the learning objectives afforded by a traditional laboratory experiment.