A novel analysis method for tension estimation of cross-linked suspenders based on single vibration measurements

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While the use of vibration measurements to detect axially loaded forces is a well-established scheme for the diagnosis of tensioned slender members, the traditional approaches are not feasible for suspenders and cables which are attached with transverse fasteners. In order to utilize the various formulas associated with vibrations of a simple slender member, the evaluation process for linked suspenders generally requires unlocking and reconnecting of the fasteners during performing vibration tests. Thus, it raises both safety and extra cost issues when planning a diagnosis scheme. This paper presents an innovated idea of using single vibration measurements with simple analytical models to develop an effective technique to estimate tension of individual member for cross-linked suspenders. The development of the technique relies on the use of simplified string formulas such that iterative approximations with numerical coding can be effectively executed for both the backward estimation and forward verification stages of the assessment procedure. In addition, this work involves demonstrations in which a wireless accelerometer of relatively low cost yet highly effective has been employed to facilitate a quick diagnosis process in field. The feasibility of the proposed method has been numerically studied and verified with selected data from field tests. It is anticipated that the procedure can serve as a better on-site tool for the vibration tests of fastener-restrained suspenders and cables.