A method for the identification of hydraulic damper characteristics from steady velocity inputs

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1. Introduction

It is shown in the published literature, for example [1–3], that complex fluid dynamics phenomena occurring in hydraulic dampers can be, in the low frequency range (from 0 to 30 Hz according to Duym [4] and Yung and Cole [5]), efficiently modelled on the basis of hydraulic system theory, described in Ref. [6]. This theory addresses first order dynamic effects observed particularly in the damper velocity-force characteristics in the form of the “hysteretic” loops. These loops are manifestations of the internal dynamic relationships and the physical effects occurring typically in high-pressure hydraulic systems, [7,8], which include fluid compressibility [6], fluid inertial effects [9] and other dynamic effects. Hydraulic system theory can accommodate these effects during the modelling process and it has traditionally been used in the damper and hydraulic actuator modelling communities for the last few decades, [1,10]. Moreover, this theory is amenable to other physical domains such as mechanical [11] and thermal domains [12]. Also, it is often used in the context of multi-disciplinary [13] and mechatronic studies [14].

Important elements in hydraulic system modelling are steady state models of the flow transporting or restricting elements such as pipes, valves, orifices or leakage paths. Characterisation of these elements was a traditional field of