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## Quantification of boxing gloves damping: method and apparatus

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### Abstract:

*In the present work, a new non-destructive method for quantifying amateur boxing gloves damping is proposed. This method is based on the determination of the relative variation of punch's energy or acceleration; a damping factor is defined to assess the damping ability of the glove. The compression of the glove is also quantified by defining, as a new parameter, the compression ratio. The designed impactor is described and the performed measurements are presented; six 10 oz competition gloves, including three new and three worn gloves, are tested using three shock energy levels of 4, 18 and 44 J. The damping factor values range between 0.04 and 0.92 depending on the glove condition and its effectiveness in attenuating the punch intensity. At weak and moderate impact energy levels, the compression ratio values are significantly smaller for new gloves than for worn gloves. At high energy level, the two types of gloves exhibit similar compression ratio values but quite different damping factors.*

**Keywords:** *Boxing glove; Damping factor; Compression ratio; Impactor; Kinetic energy; Punch velocity; Torsion bar.*

### 1. Introduction

In amateur boxing, an Olympic sport since 1904, boxing gloves are the main protective gear worn by boxers to absorb and dissipate some of the punches' energy exchanged between boxers; boxing gloves significantly reduce the intensity of impacts to ensure the protection of both the boxer's and the opponent's hands [1,2]. Despite using boxing gloves, a significant number of hand, finger, and wrist injuries are reported [3]. These lesions which include fractures, dislocations, and contusions, occur in both competitions and training [4,5]. To make amateur boxing safer, approved gloves allowed in competitions [6] are made of high-quality leather whose weight does not exceed half of the total glove's weight. Padding material should neither move nor be damaged in order to absorb a maximum energy from the punches. In contrast to the protective equipment for other sports, few studies have been reported in the literature about boxing gloves and their ability to attenuate punches energy. More than thirty-year-old results [7-11] seem now outdated since padding gloves at that time consisted of a horsehair layer sandwiched between two low-density foam layers, all covered with natural leather [9]. Current glove manufacturing processes and materials have undergone major changes throughout these decades.

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