Calculation of Mountain Bike Suspension Setup through Mobile Image Analysis

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Abstract

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1 Introduction

1.1 Context

A survey carried out by the International Mountain Bike Association shows the average price of mountain bikes owned in Europe to be €2546 (£2206) (IMBA Europe, 2015). Starting at around £1000 (Giant Manufacturing Co. Ltd., 2017), enthusiast level mountain bikes can be purchased with suspension for both the front and rear wheels, known as Full Suspension (FS) bikes. Even at this comparably low cost, the suspension units have multiple adjustments available to tune and personalize how they operate.

To ensure the fork and shock function correctly they must be set up for the rider's weight and intended use of the bike. As this is considered a specialist area, many entry and mid level riders will lack the knowledge of this process or be unsure of how the suspension should operate meaning the rider could use the bike without the suspension set up correctly.

It has been proven that using a FS over a Hard Tail (HT) offers a performance advantage to the rider (Titlestad, Fairlie-Clarke, Davie, Whittaker, & Grant, 2003). However if the suspension fork and/or shock have not been set up, it can be detrimental to the rider's performance and potentially lead to injury. For example, if a shock has too little rebound damping set and the rider goes off a jump, the excessive speed at which the rear of the bike extends can create forwards rotation, causing the rider to go over the handlebars of the bike.

Additionally, an incorrect suspension setup can cause excessive wear and tear on the bike's frame and components. Suspension which is set too soft can allow for bottoming out which expends excess forces into the frame and potentially cracks the frame's structure. Suspension set too hard forces energy, which it would normally soak up, into the wheels and tires causing denting and warping of the wheel rims.

Many bicycle retailers will set up the suspension on a newly purchased mountain bike for the customer on delivery. Most of the time this will be enough to avoid incident but due to the extra weight of the equipment riders use, i.e. helmet, hydration pack, body armor which the customer will not be wearing at the time of delivery, this setup is regularly inaccurate. Furthermore, with some manufacturers choosing direct sales over local retailers (Harker, 2010; Staff, 2015), this setup can be circumnavigated altogether.

Since the birth of the modern smartphone in 2007 brought along by the first generation Apple® iPhone® and introduction of the Android™ mobile operating system, the use of mobile computing in everyday life has grown rapidly. Google™ stated that there were approximately 1.4 active Android users worldwide in 2015 (Callaham, 2015).

The introduction of activity tracking devices and mobile applications such as FitBit (Diaz et al., 2015) and Strava (West, 2015) and their growing popularity (Formosa, 2012) shows that individuals are welcome to the idea of using smartphones to aid or augment their participation in hobbies or sports. Due to this popularity and in a bid to give every rider the ability to setup and tune their own suspension, either at home or while out on a ride, companies have set about producing small devices (Aston, 2016; Hwang, 2016) and mobile applications (Benedict, 2012) which aid riders in the process.

1.2 The Physics of Mountain Bike Suspension

The purpose of suspension on a mountain bike is to divert energy from bumps and rough features in a trail away from the rider to improve comfort and aid in performance. This requires the use of a shock absorber, and linkage system in the context of rear suspension, which allows the wheel to travel away from the feature when it makes contact and return once it has been passed. Mountain bike suspension is divided into two separate systems, the front and rear.

1.2.1 Front Suspension

Front suspension commonly employs a linear telescoping shock absorber where the stroke of the shock is one to one with the potential travel of the wheel.

2 Literature Review

3 Approach

4 Results

5 Critical Evaluation

6 Conclusion

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Acronyms

FS Full Suspension. 5, *Glossary:* full suspension

HT Hard Tail. 5, *Glossary:* hard tail

Glossary

Fork The front suspension unit on a mountain bike. 5

Full Suspension A mountain bike with both front and rear suspension. 5

Hard Tail A mountain bike with only front suspension. 5

Rebound Damping Controls the speed at which a suspension unit extends once it has been compressed. Less damping means the unit extends faster. 5

Shock The rear suspension unit. Only found on full suspension mountain bikes. 5