Determining Bicycle Braking Performance with enDAQ Sensors

SNAPSHOT:

Challenge
Determine bicycle braking performance in different brake designs and applications

Solution
Apply an enDAQ sensor to eight different bicycles to measure deceleration

Result
Quantified deceleration rates of bikes with either rear only or both with front and rear braking

Challenge

Nick Famiglietti and his colleagues at Momentum Engineering Corp. (MEC), a consulting firm that specializes in accident reconstruction, noticed a gap in the research surrounding bicycle crashes. “There wasn’t a lot of strong data about bicycle braking,” said Famiglietti. An accident reconstruction firm may see a case that involves a BMX bicycle crash, but only have data and research from a road bicycle, which would only provide a somewhat accurate picture of what happened during a crash. To accurately answer the question of how fast a bicyclist was going, the engineers at MEC needed to get comprehensive data about the nature of bicycle braking from a range of bicycles. To do this, they would need a portable device small enough to fit on a bicycle that would deliver reliable and actionable data from their testing.

“The enDAQ sensor is by far the most affordable unit that satisfies the J211 standard.”

Solution

Using an enDAQ sensor (S4 - E25D40) that satisfies the SAE-J211 standard for vehicle impact testing sensors, MEC measured the deceleration rates of eight different bicycles during brake-to-stop tests with a single person riding at the same location. MEC used their sensor data to measure the deceleration that occurs in the initial phase of braking where the bicyclist is squeezing a lever and the bike begins to decelerate and then the incipient lock-up phase where a skidmark is left.

About Momentum Engineering Corp.

Momentum Engineering Corp. (MEC) is a consulting firm specializing in accident reconstruction, forensic engineering, heavy truck safety, graphics and animation. With over 50 years of accident reconstruction experience, they offer accident reconstruction and investigation services ranging from rapid response to final trial testimony. They will provide clients with state-of-the-art accident reconstruction services in a cost-effective manner.

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Read Momentum Engineering Corp.'s technical paper in SAE International:

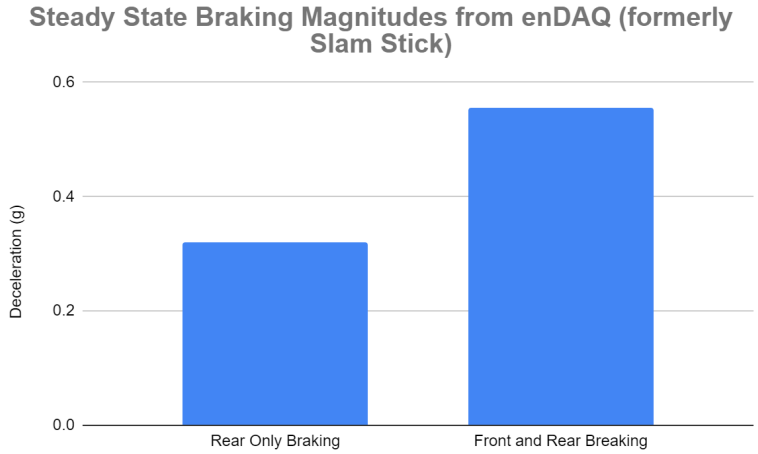
Bicycle Braking Performance Testing and Analysis

Over three days, MEC conducted three tests. They configured their enDAQ sensors to record on day one at 3200 Hz, 100 Hz on day two, and at 800 Hz on day three. They then secured their enDAQ sensor to the top tube of the bicycle frame between the seat and the handlebars. MEC wanted something small and easy to attach to the bicycles that wouldn't add much weight or impact the center of gravity as any changes would affect the results of their testing.

"We like the enDAQ sensor specifically because it's so small... it also has an integrated battery and it's really easy to use."

By using an enDAQ sensor, MEC saved significant time in their testing. Compared with other units commonly used in crash testing that are larger and often require hooking up to a laptop with every trial, a configurable enDAQ sensor begins to record with the push of a button and has an integrated battery which was beneficial to MEC's testing environment.

MEC also used video to document their brake test. By programming the UTC timing on the sensor so that the data had a timestamp on it, they were able to synchronize the data from the brake test with the video for an effective analysis.



Contact

Feel free to contact us for more information about our enDAQ products.

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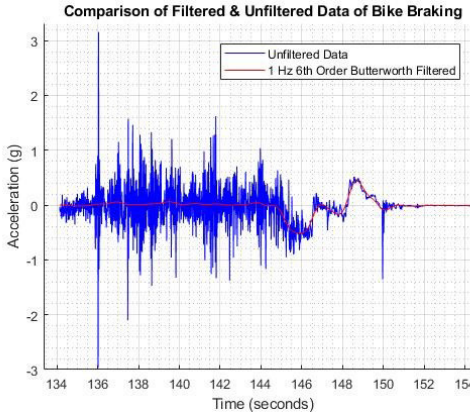
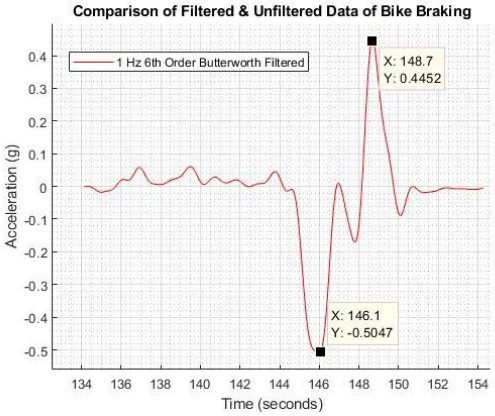
Results

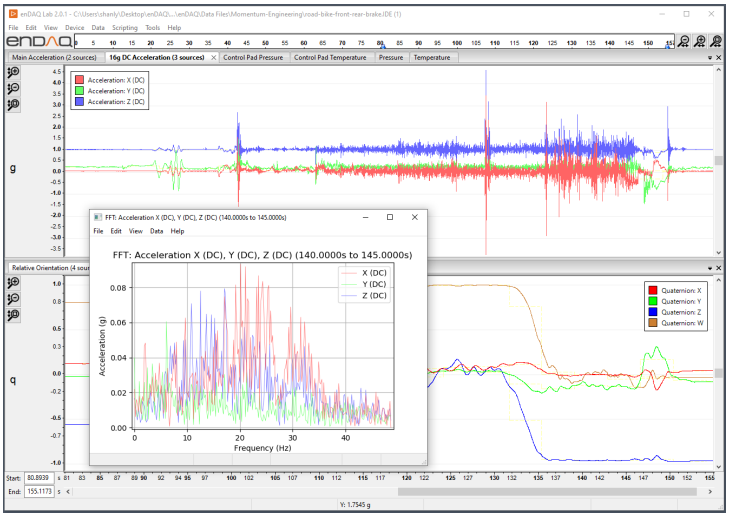
Using the enDAQ sensor, MEC was able to quantify deceleration rates of bikes with either rear only or both with front and rear braking. These rates were quantified for different specific bikes in both brake design categories which introduce added variability.

During testing, the 16g DC response accelerometer recorded a lot of vibration information which was of no interest for evaluating the deceleration rate from braking. By applying a low pass filter using enDAQ Analyzer software, the data of interest was isolated.

Further, Famiglietti and his team were able to publish their findings as a technical paper in the industry journal, *SAE International*. Using data garnered from the enDAQ sensor, they were able to demonstrate the magnitudes of how hard the eight different bicycles decelerated. Upon publishing this paper, Momentum Engineering Corp. is able to rely on this valuable data for legal opinions involving bicycle crashes.







Screenshot of the full test of the road bike with both front and rear brakes