Trinity College Dublin
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Graphene/Polymer Nanocomposite Strain Sensors – Power Meter & Cadence Sensor Based on Lateral Frame Deflection

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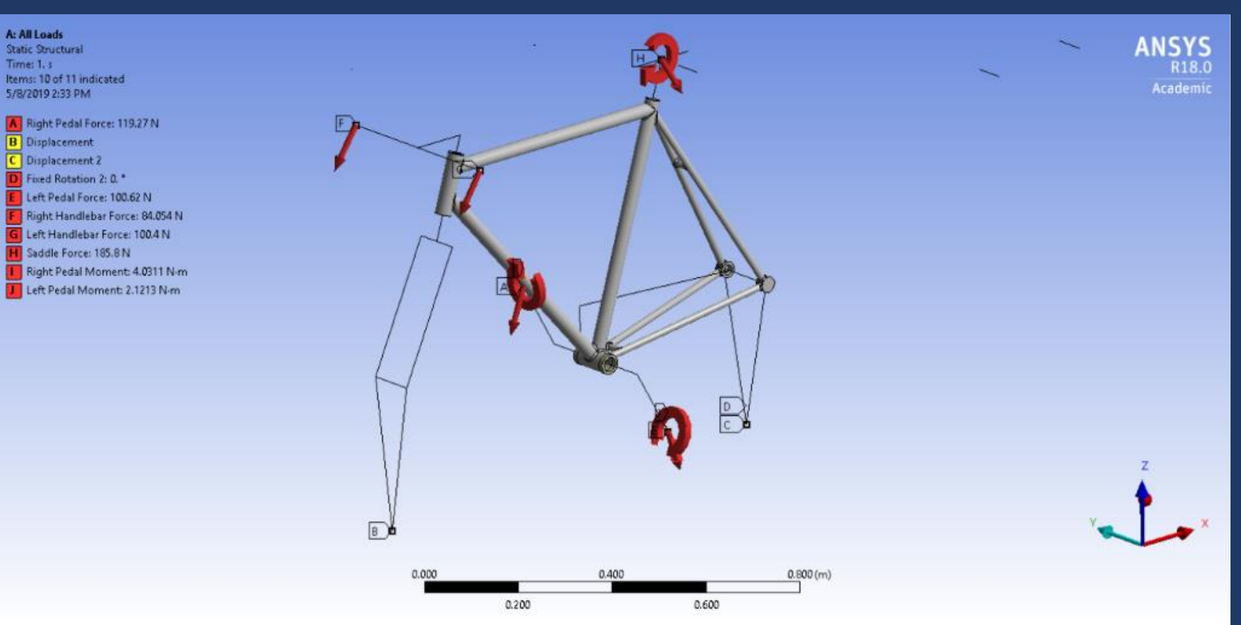
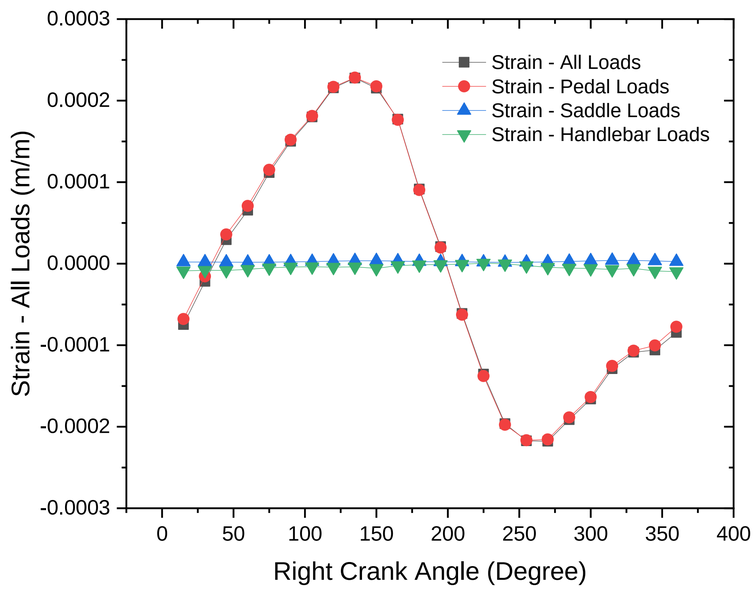
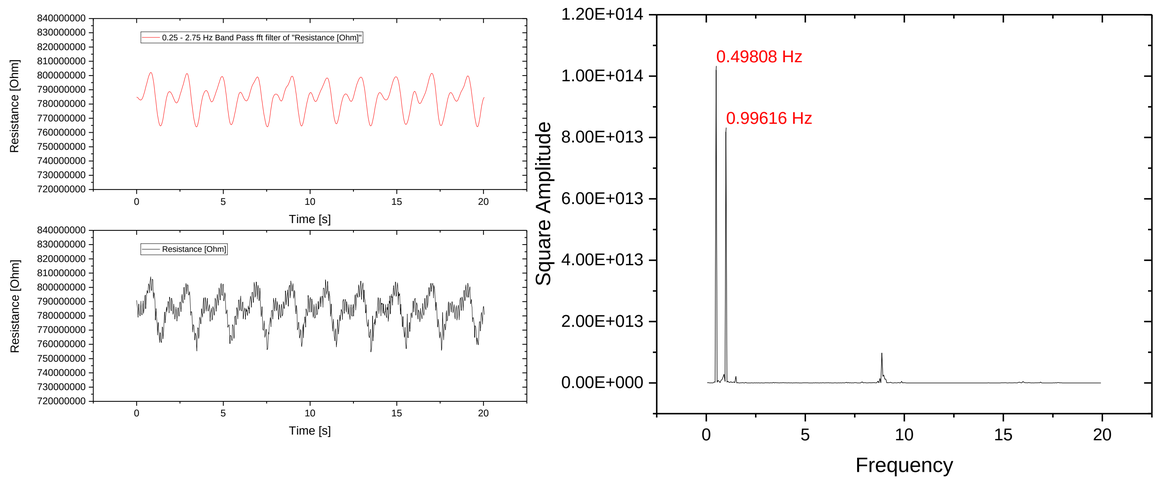
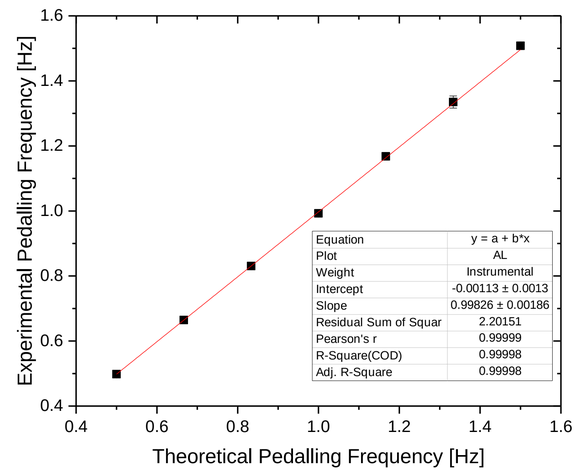


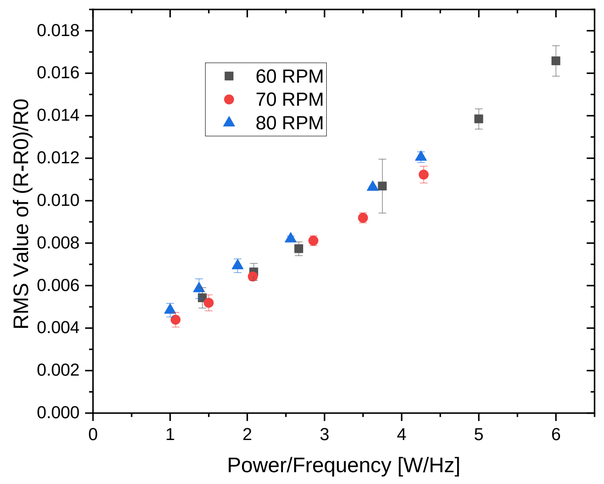


The Finite Element Analysis method designed during this project is depicted above. The Cranks of the bike are parameterized at 24 separate angles. The corresponding rider-induced loading data is applied to each of the 24 simulations with different crank angles. This gives a complete picture of how the bike frame deforms in real time, throughout the pedal stroke. Each set of loads (pedal loads, saddle loads, and handlebar loads) were applied to the model individually do see the contributions of each load set to the strain at any given point. At the lower part of the seat tube, a small region was found to deform laterally and almost completely due to the pedal loads. This is theoretically the ideal position to mount the power meter/cadence sensor

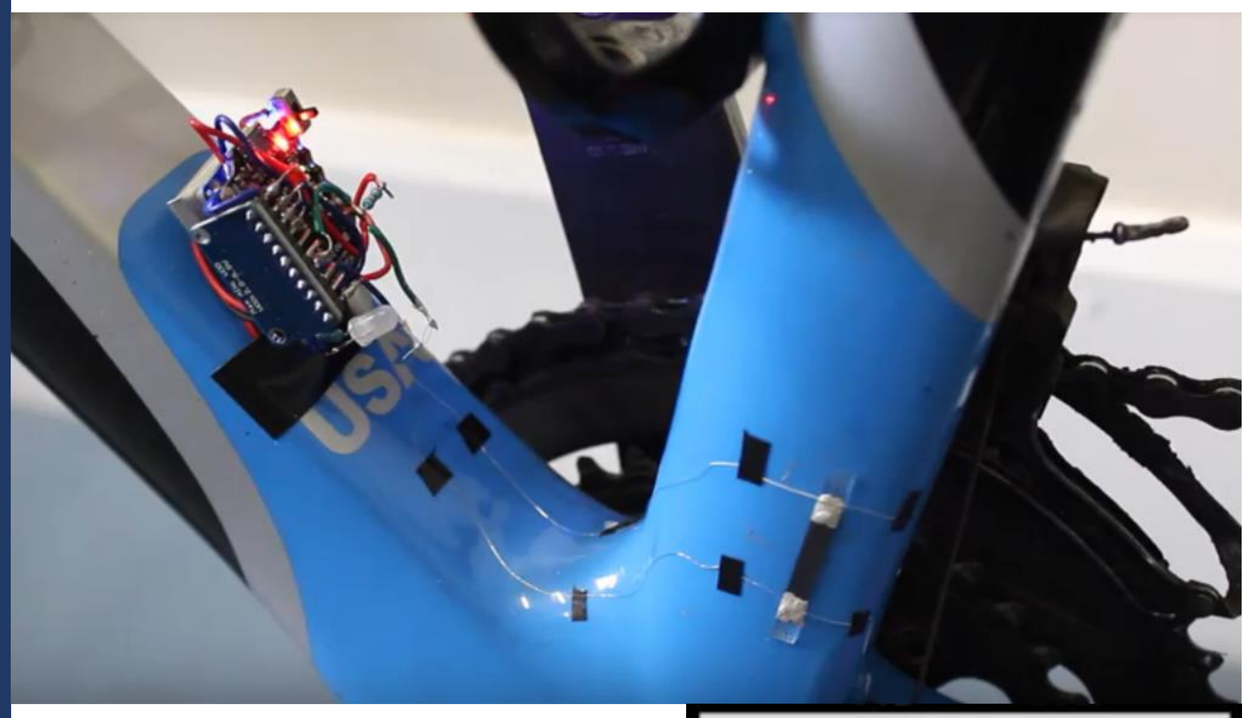


The self-adhesive, graphene/polymer nanocomposite strain sensor was applied at this theoretical ideal region. The resistance response is shown to the right. It has a clear cyclical nature. The pedalling frequency was kept constant at 30 RPM for the test. The Fast Fourier Transform (shown right) of the signal shows that the dominant frequency of the signal was 0.5Hz which perfectly matches the pedalling frequency or cadence.





The test was repeated for many different pedalling frequencies. Each time, the dominant frequency of the Fast Fourier Transform perfectly matches the pedalling frequency (shown left). As Well as this. The RMS value of the curve was divided by the pedalling frequency and plotted against the power output of the signal (shown right). The is an obvious correlation between the two, proving that the sensor is in fact straining due to the loading applied at the pedals which is proportional to the power output.



A portable prototype was made using an Arduino with a built in Bluetooth Low Energy module at its core. This senses the resistance of the graphene/polymer nanocomposite strain sensor. It is programmed to calculate the Fast Fourier Transform of the resistance response. The resistance response is plotted in green. The Pedalling frequency or cadence is plotted in blue, just below.

Acknowledgements

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