



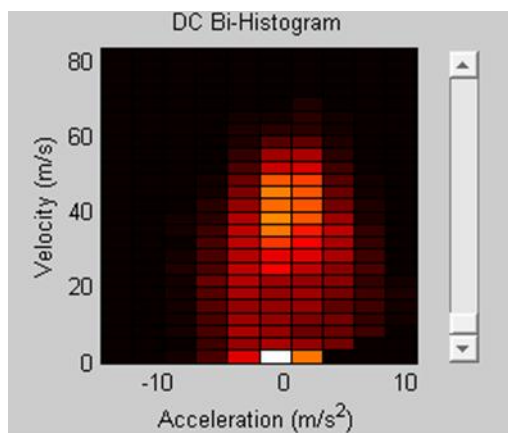
Duty Cycle Generation Tool (DCGenT)

The Energy and Transportation Science Division of the Oak Ridge National Laboratory saw the need for a tool that helps analyze drive cycles (DCs) and generates shortened synthetic DCs that are representative of a large data set that includes many hours or days of driving. Unlike consumer vehicles, many heavy duty truck applications do not have established DCs. DCs that are characteristic of driving for a specific truck application allow better understanding of the truck in operation. The Duty Cycle Generation Tool (DCGenT) focuses on recreating a DC with the same characteristics of the original set of data, but with a shortened drive length.

The MATLAB® based DCGenT manipulates user inputted data and will automatically create a synthetic DC within user-specified error thresholds. Users simply load comma separated value (csv) files with the following values:

- Velocity (required);
- Elevation;
- Fuel Rate;
- Engine RPM; and
- Engine Torque.

DCGenT calculates the acceleration from the input velocity and displays a velocity and acceleration bi-histogram which depicts the distribution of specific correlations between acceleration and velocity (e.g. how often does the DC spend in the highest velocity range and what accelerations occur at the velocity). A metric known as tractive power is also calculated and displayed in a



Velocity and Acceleration Bi-Histogram showing distribution of acceleration events

similar histogram. Tractive power is the relationship between aerodynamic drag, kinetic energy, potential energy and rolling resistance.

If the user decides to create a synthetic DC from selected data set, DCGenT will then section the original data into 4 distinct segment types:

- Acceleration from zero;
- Decelerating to zero;
- Stopped (idle); and
- All other sections.

The segments are then randomly sampled from based on characteristics of the original DC and “pasted” together to create a synthetic DC. Synthetic cycles are continuously created until all metrics are within the user specified error threshold. These metrics include but are not limited to the time spent accelerating, the time spent deceleration, average speed, maximum speed, root mean square of the bi-

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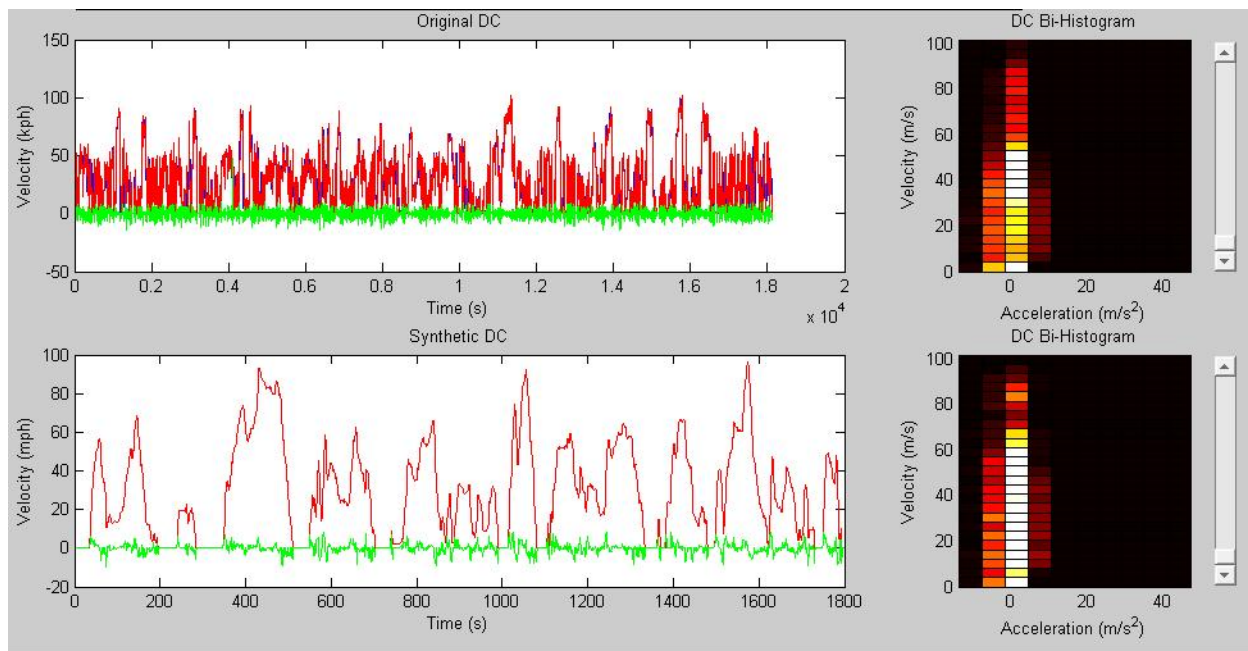
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histogram, and the relative error in the norms of the original and synthetic speed-acceleration bi-histograms. Typical synthetic DCs are between 20 and 30 minutes and sometimes as long as 1 hour. This is considerably shorter than the original DC which can range from tens of hours or days of data.

Once the synthetic DC is created, it can then be used in various analysis and modeling programs to

calculate fuel economy, emissions and other important vehicle characteristics. Benefits of this include analyzing cost-benefit of adding fuel saving technologies such as side skirts or wide single tires and purchasing vehicles that are best suited for the specific type of DC a fleet has. Also a carrier has the ability to use the synthetic duty cycle in cooperation with OEMs to select the best vehicle for their specific operation.



DCGenT interface showing both the original data (top plot) and the synthetic data (bottom plot). The original set of data was originally 18000 seconds and was shortened to 1800 seconds in the synthetic histogram with a maximum error in major metrics of 7%.