# Chapter 6

# Conclusions

This chapter provides a summary of the research presented in the earlier chapters. It also includes several recommendations for future research related to modeling rail irregularities.

## 6.1 Summary

The characteristics of the irregularities inherent to railroad tracks were analyzed using statistical and frequency analysis techniques. The results were used to form an analytical model that can be used to create track data, based on track class, with the same characteristics and dynamic behavior of an actual track.

The characteristics of the irregularities associated with the alignment and profile data, from track data measured at the Transportation Technology Center, Inc. (TTCI), were determined by performing a statistical and frequency analysis. A distinct value for the standard deviation for each class of track was established, along with a common bandwidth for the frequency content of all tracks.

The results of the data analysis were applied to TRAKVU, a track preprocessor that works with the rail vehicle dynamic modeling program NUCARS. TRAKVU is capable of creating analytic track data for use as the input to a dynamic model. Track irregularities can be added to the track in various forms, such as random, basic shapes, and track class. Track class irregularities are generated by using the results of the data analysis.

The track model was then validated by performing several comparisons. First, a direct comparison of the TRAKVU track characteristics to the characteristics of actual track was performed. Next, the predicted dynamic response of a NUCARS model using track created by TRAKVU was compared with both the actual vehicle response and the predicted dynamic response of a NUCARS model using measured track data.

The results of the validation showed that TRAKVU is able to recreate the characteristics of an actual track. There was also a good comparison between both of the predicted responses. The modeling results with TRAKVU, however, did not compare as favorably with actual test data, perhaps due to the dynamic model's inaccuracies.

## 6.2 Recommendations for Future Research

The results of this research indicated that, overall, the irregularities associated with the alignment and profile data can be accurately characterized and analytically created. Possible future research in this area includes repeating the data analysis with more measured track data, preferably main line data in space curve form, and determining improvements to the models documented here for representing track irregularities. Using other vehicle models and tracks for validating TRAKVU also deserves further attention.

By analyzing space curve data, a better representation of the frequency content can be examined. The potential for improving the frequency composition of the created track data can be attained by investigating other filtering methods.