Ph.D. Defense  
Tuesday, July 28, 10:00 am – 12:00 pm  
Room 3546D EB

Local calibration of the pavement performance prediction model using resampling techniques  

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Abstract:  
The performance prediction models in the Pavement-ME design software are nationally calibrated using in-service pavement material properties, pavement structure, climate and truck loadings, and performance data obtained from the Long-Term Pavement Performance Program (LTPP). The nationally calibrated models may not perform well if the inputs and performance data used to calibrate those do not represent the local design and construction practices. Therefore, before implementing the new M-E design procedure, each state highway agency should evaluate how well the nationally calibrated performance models predict the measured field performance. The local calibration of the Pavement-ME performance models are recommended to improve the performance prediction capabilities to reflect the unique conditions and design practices. During the local calibration process, the traditional calibration techniques (split sampling) may not necessarily provide adequate results when limited number of pavement sections are available. Consequently, there is a need to employ statistical and resampling methodologies that are more efficient and robust for model calibrations given the data related challenges encountered by State Highway Agencies.

The main objectives of this study were to demonstrate the local calibration of the rigid and flexible pavement performance models and compare the calibration results for different resampling techniques. Additionally, the input and measured performance data collection efforts were established for Michigan. The flexible alligator cracking, rutting, thermal cracking and IRI models were locally calibrated for Michigan conditions as well as the rigid pavement transverse cracking, faulting and IRI models. Several different sampling techniques and dataset options were utilized to calibrate each model. These datasets included combinations of pavement types such as newly reconstructed, rehabilitation and LTPP sections. Initially, the models were calibrated using the entire dataset, then split sampling was performed. Due to limitations of these techniques, repeated split sampling, bootstrapping and jackknifing sampling techniques were used to randomly select pavement sections for local calibration. The bootstrap is a nonparametric and robust resampling technique for estimating standard errors and confidence intervals of a statistic. The main advantage of bootstrapping is that model parameters estimation is possible without making distribution assumptions. The major findings from this work is to demonstrate the use resampling techniques to locally calibrate the performance prediction models for newly constructed and rehabilitated pavements. The results of local calibration and validation of various models show that the locally calibrated model significantly improved the performance predictions for Michigan conditions. The local calibration coefficients for all performance models are documented. Additionally, recommendations for future calibrations are presented to improve the current local calibration.