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NYU Center for Urban Science + Progress

Road Roughness and Vehicle Speeds

Data driven Mobility Modeling and Simulation

By

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BACKGROUND

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› Potholes, Pavement Defects or Pavement Roughness leads to defensive driving

› Result could be an inefficient flow of vehicles, fuel inefficiency and discomfort to drivers

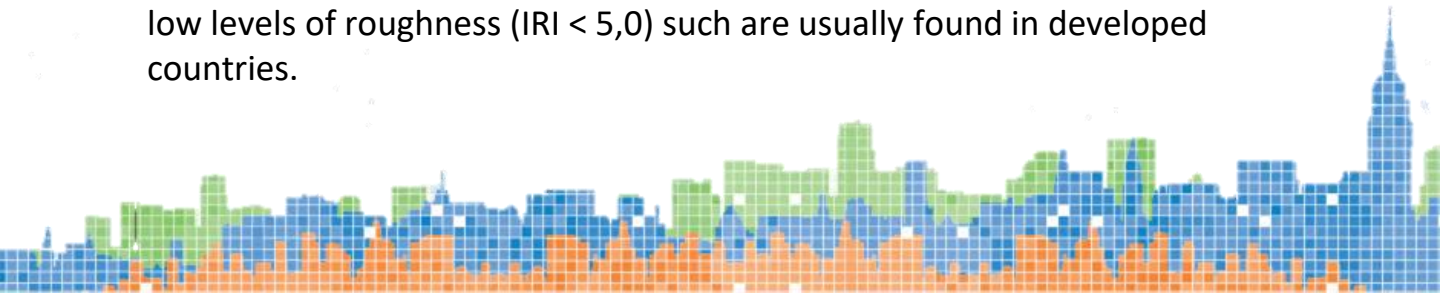
PROJECT GOAL

- **Explore the relationship between Road Roughness and Vehicle Speeds**
- **Build a model to predict the Vehicle Speeds based on the Vibration and Length of the Road Link Data**

Road Network of Syracuse, NY

RECAP OF PAPER REVIEW

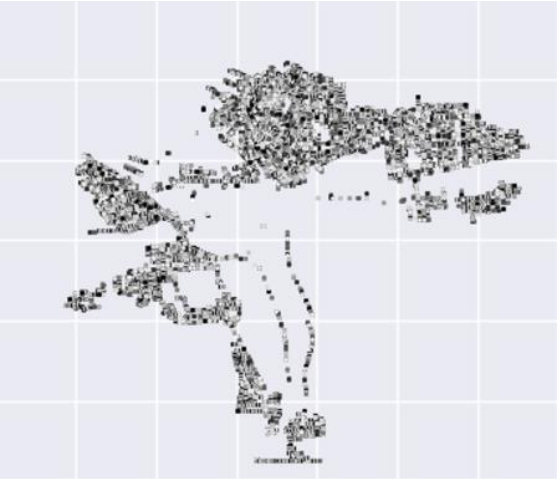
- Multivariate analyses found statistically significant roughness effects
- HDM-III model developed a generalized roughness-speed model, but cannot ensure the accuracy of the prediction in all types of conditions
- Given the multiplicity of factors influencing speeds it is not always certain that the roughness effects have been accurately isolated.
- Limitations exist when trying to do predictions based on a wide variety of Data Sources
- The roughness effects can be expected to be small, particularly on roads with low levels of roughness (IRI < 5,0) such are usually found in developed countries.



DATASET

Syracuse, New York

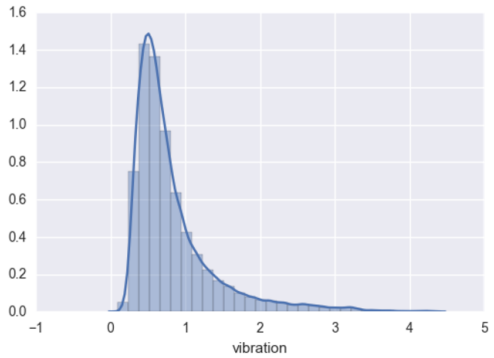
- Point Vibration and Vehicle Speed Data collected in Syracuse, NY
- Only used the data from Residential Segments
- Road Length Data From OpenStreetMap
- Net Vibration of X,Y,Z components was used
- Note: This data was collected by only one car in controlled conditions



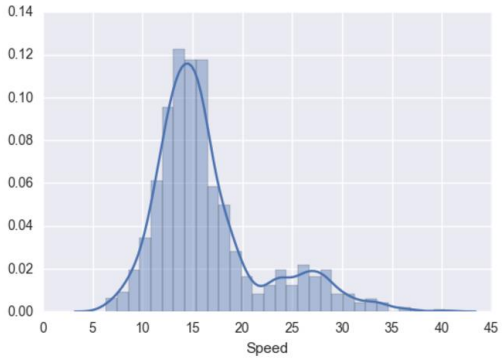
Point Vibration, Speed Data collected (Residential Roads)

ANALYSIS

Data Distributions



Distribution of Point Vibrations Data

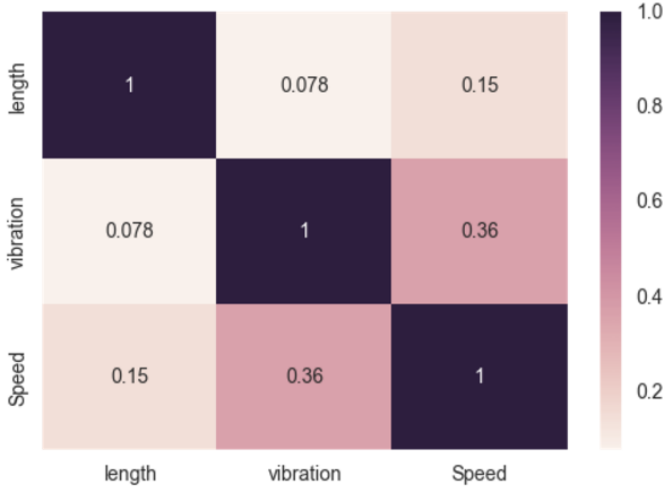


Distribution of Mean Speeds along Road Links

- The Net vibrations data has a mean value of 0.83 and median value of 0.65
- Mean Speeds are concentrated between 12-18mph indicating the controlled driving that was done in this case.
- Speed Limit across all the roads considered was 30mph

ANALYSIS

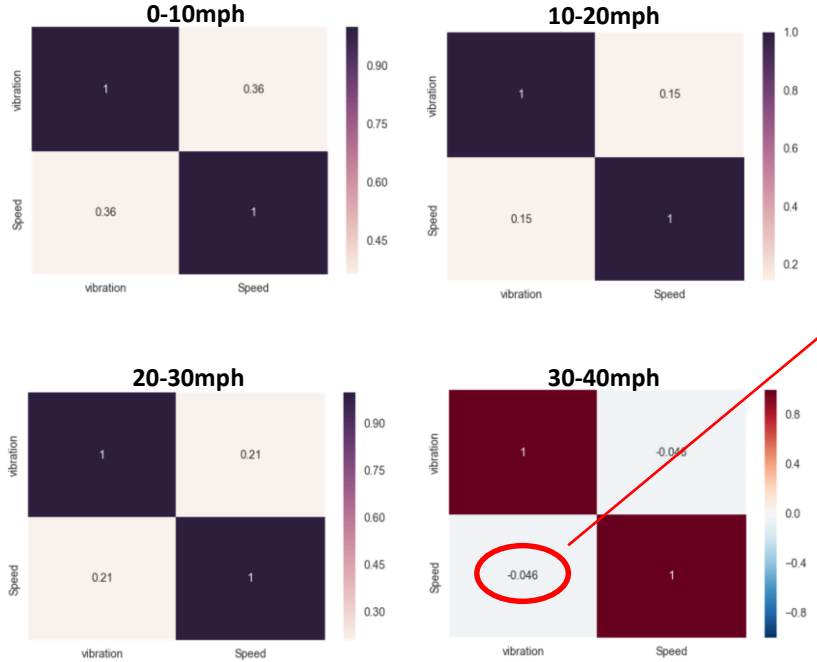
Length, Vibration and Speed Correlations



- Desired correlation between Speed and Mean Vibration was Negative
- But the result was a positive correlation
- Reason: Vibration on a vehicle keeps increasing with speed until a threshold speed
- In this case, vehicle speeds were pretty low
- Binning the Speed Data in 10mph intervals

ANALYSIS

Correlation with Mean Vibration in 10mph bins

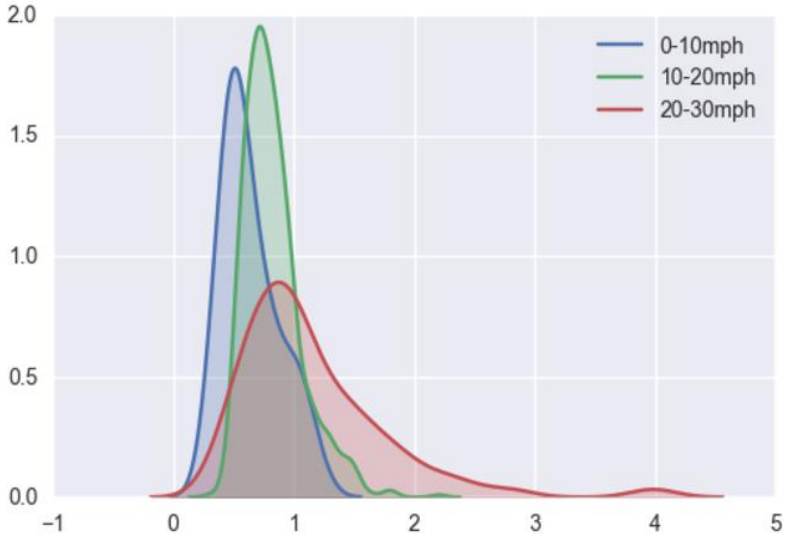


- Negative Correlation after 30mph is indicative of the threshold
- But the correlation is very weak

ANALYSIS

Shift in Distribution with Speed bins

- We can observe a shift in the distribution of vibrations for each speed bin of 10mph
- After 30mph, the distribution is shifting backwards *not in graph



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Correlation with Max Vibration

- Max Vibration was taken to check the effect of a major road defect on average speed.
- This has shown a negative correlation indicating that the larger the road defect, the lower the vehicle speed

ANALYSIS

Univariate Regression between Vibration and Speed

OLS Regression Results

Dep. Variable:	Speed	R-squared:	0.732
Model:	OLS	Adj. R-squared:	0.731
Method:	Least Squares	F-statistic:	2316.
Date:	Thu, 04 May 2017	Prob (F-statistic):	8.14e-245
Time:	03:20:34	Log-Likelihood:	-3075.9
No. Observations:	850	AIC:	6154.
Df Residuals:	849	BIC:	6159.
Df Model:	1		
Covariance Type:	nonrobust		

	coef	std err	t	P>|t|	[0.025	0.975]
vibration	5.8564	0.122	48.126	0.000	5.618	6.095

Omnibus:	98.804	Durbin-Watson:	1.784
Prob(Omnibus):	0.000	Jarque-Bera (JB):	132.152
Skew:	0.910	Prob(JB):	2.01e-29
Kurtosis:	3.649	Cond. No.	1.00

WAY FORWARD

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- Use INRIX Vehicle Speeds Data instead of point speeds
- Include other data sources like No: of Lanes, Annual Daily Vehicle Traffic etc.
- Acquire flow data from DOT Traffic Cameras in New York City
- Clustering similar roads and vibrations for better categorization of Speed + Vibration Data
- Try different transformations like Logarithmic to get a better model

THANK YOU