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- With what accuracy can the vertical translation of a sensor on bridge 705 be predicted without temperature effect?

Temperature may cause a temporary change in vertical translation. A model `T` based on a number of variables such as air temperature can be built in order to predict the effect of temperature on a structure. However in this problem domain generating data via simulation is necessary, and so the model `T` must be used instead to simulate the effect of temperature, and of course the same model `T` cannot simply be used to predict and remove the simulated effect. To convince ourselves that removal of the temperature effect would work in real life, a simple and robust technique should be used. After removal of the temperature effect what remains is the effect due to live load and additional effects as seen in Figure A.

Removing the temperature effect from a number of sensors based on regression of the previous year's responses against air temperature measurements CITE, and fitting a curve to 24 samples taken in a 24 hour cycle CITE, the mean effect that was not removed due to temperature is 15%.

- What sensor threshold value is appropriate to trigger warnings when pier 5 of bridge 705 is settled by $3mm$? (**Q.2**)?

The tensile strength of concrete is $\approx 3\frac{N}{mm^2}$. Stresses will occur on the bridge due to a number of different effects. Based on Figure F, the combination of live load, temperature effect on the hottest day of the year, and pier settlement of Nmm, the tensile strength of concrete will be exceeded. Therefore $3mm$ is a safe value at which point the tensile strength of concrete will unlikely to be exceeded. A single sensor (Figure G) is chosen in the vicinity of pier 5. Two time series of responses from July to December are generated, one time series with pier 5 settled by $3mm$ and one time series when bridge 705 is still in healthy state. A small sensor threshold value is chosen and the number of days on which each sensor is triggered is recorded. When the healthy time series triggers a sensor this is considered a false positive and when the pier settled time series does not trigger a warning this is considered a false negative. The sensor threshold must be increased to determine at which point the true classifications are maximized and the false classifications are minimized. When the threshold is too small there will be many false positives and when the threshold is too large there will be many false negatives.

- What is the minimum amount of pier settlement that can be detected for pier 5 based on the same sensor as in the previous experiment?

Building upon the previous experiment but repeating it for decreasing values of pier settlement, then at some point it will no longer be possible to select a sensor threshold value that will trigger warnings due to pier settlement but not trigger warnings due to live load and temperature effect.

- To what extent does the ability to predict the vertical translation change due to pier settlement change across bridge 705?

The effect of temperature is not uniform across the bridge, instead temperature will affect..., to think through a bit more...

- Can the change in sensor responses that occurs due to cracking be detected?

Generate multiple time series of responses, and apply the crack at a random point in the time series, the crack is assumed to occur instantly. At each minute in the simulation a comparative measure is calculated between the last minute and third last minute of responses. What value of the comparative measure maximizes the accuracy at each minute when the measure is calculated, and what is that accuracy?