Abstract Title: **Automatically Discerning Power System Dynamics in Synchrophasor Measurements Data Spectra**		
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Summary of proposed presentation (1-3 paragraphs):

One of the biggest challenges for utilities to exploit oscillation monitoring applications is the tuning online oscillation monitors (e.g., mode meters) is not knowing what are the different frequency ranges to target. This may not be an issue when system dynamics are well-known (e.g. the WECC's inter-area modes), or dynamics that can partially be explained by planning models (to serve as a guide) and those that are relatively stationary (correspond to specific frequency bands), allowing for longer estimation windows to obtain good estimates. However, the same cannot be said for local control modes, which are essential to monitor for utilities such as Dominion Energy. A key example is the need of local oscillatory behavior from generation facilities (e.g., PV plants, conventional generators) and transmission equipment (e.g. STATCOMs) to prevent different types of oscillations stemming from poorly tunned controllers, which is becoming increasingly common with a growth in renewable generation.

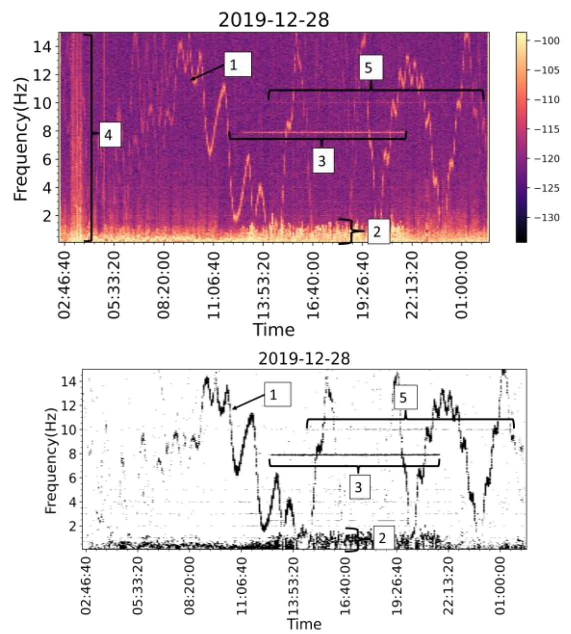

Figure 1. Example characterization of dynamics: 1. industrial motor drive, 2. fast varying mode, 3. solar mode, 4. arc furnace, 5. low energy undamped oscillation.

In this regard, this work proposes a new approach to automatically capture essential regions in the time-frequency plane that correlate to relevant power system dynamic behavior. The proposed method allows to discover and characterize new dynamic processes, track previously discovered ones, to detect ones tending to instability and finally, generate labels in historical data to enable machine learning applications for possibly learning preventive operational solutions to unmodeled dynamic phenomena. An example of the application of the method is shown in Fig. 1, where the top figure shows the a conventional time-frequency plot and on the bottom a binarized spectrogram. The binarized spectrogram allows tracking changing dynamics (e.g. no. 1 for an large industrial motor drive) with varying frequency as long as narrow-band dynamics such as those from forced oscillations from solar (see label 3 in Fig. 1).

The proposed approach exploits certain special properties of spectrograms of signals characterized by a finite number of oscillatory modes to generate an automatic threshold using image segmentation for extracting the dominant "dynamic behaviors". Results are illustrated using real-world data from Dominion Energy's service territory.

Statement of novelty or impact, answering the question why would the NASPI community benefit from receiving this presentation? (1 paragraph): With the growth of renewable generation, utilities are faced with a major challenge of having a limited ability to anticipate dynamic performance issues, particularly due to the performance of local inverter-based resources (IBRs) controllers and other power electronic-based devices (e.g., STATCOMs). This stems from lack of access to transparent and accurate models coupled with changing grid conditions deeming pre-existing control designs inefficient or in worse case designs that result in unstable local dynamics. Luckily, owing to a continuity and periodicity in grid operating conditions, it is generally possible to associate oscillations stemming from unstable controllers to some an underlying culprit dynamic phenomenon (i.e., a particular mode) in ambient conditions and consequently, such events are preventable in theory if discovered and characterized on time, which our work attempts to solve.
Finally, our work allows us to discover and characterize system dynamics without prior knowledge. Unlike existing approaches that leverage well known behavior, i.e., the frequency bands for specific modes, this work does not assume this previous knowledge.