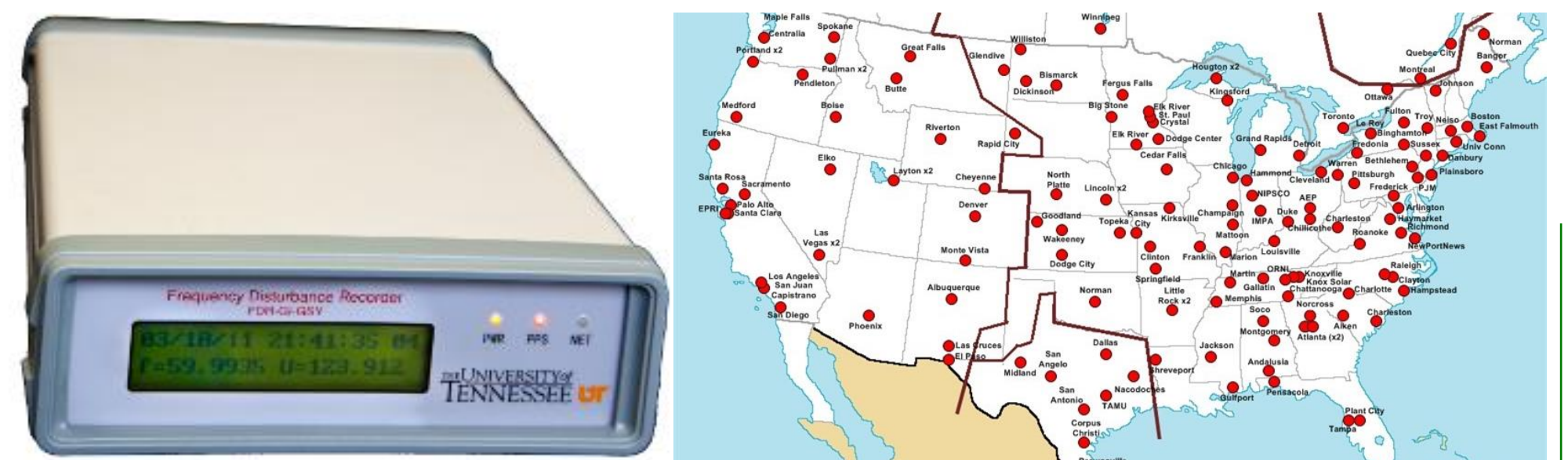


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Introduction

FNET is a frequency monitoring system. Using FDRs (Frequency Data Recorders), it is possible to generate an animated 3D map of frequency and voltage angles across the grid. 3D mapping of this data would allow for greater analysis of the dynamics of a power system. In addition, it would be much easier to pinpoint the location of a major event or disturbance.

FDR & Distribution Map



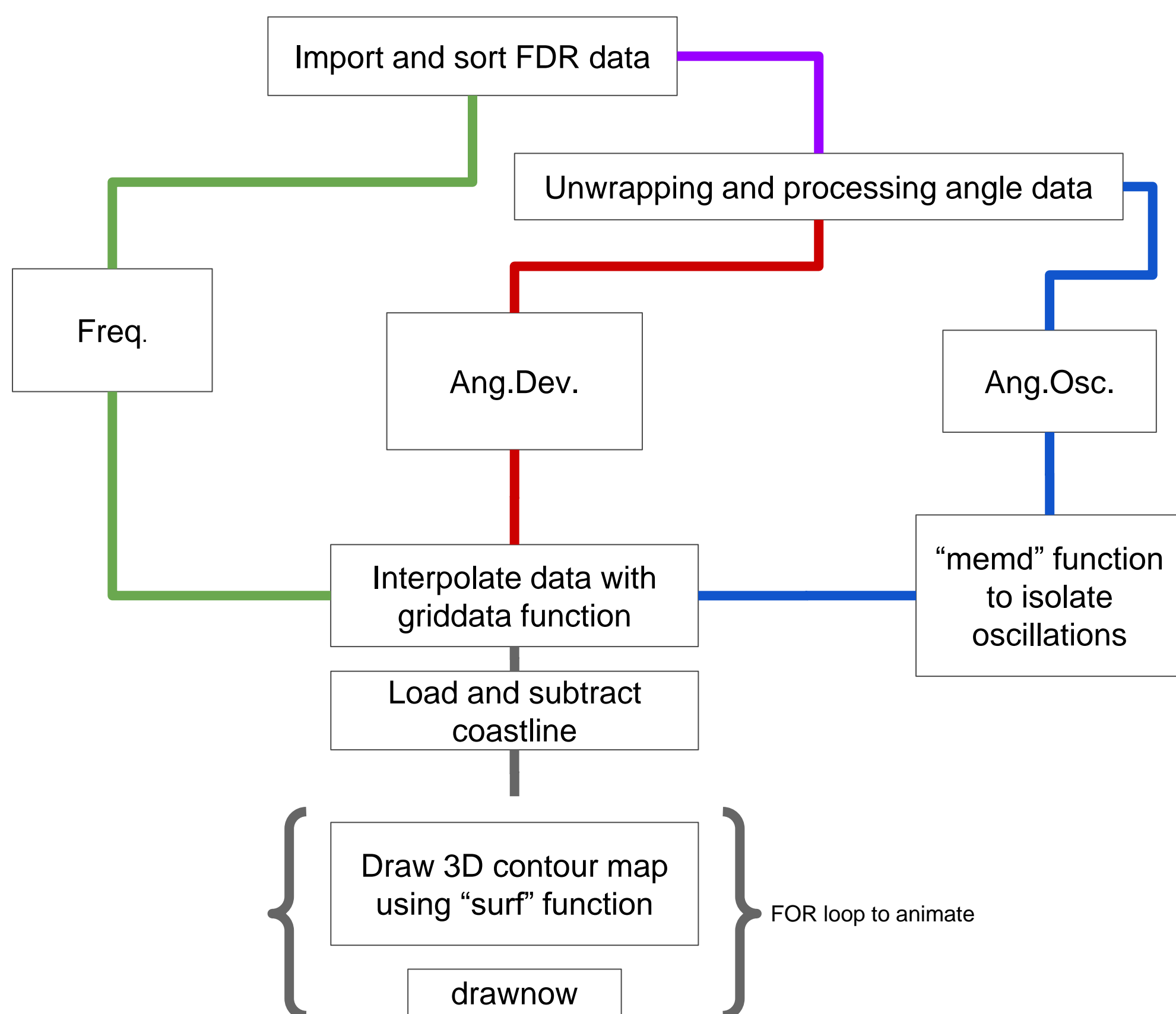
Objectives

- Visualize the frequency and voltage angle data from FNET as an animated 3D contour map.
- Create an automated program
- Understanding how this new imaging can provide better insight into the electrical grid.

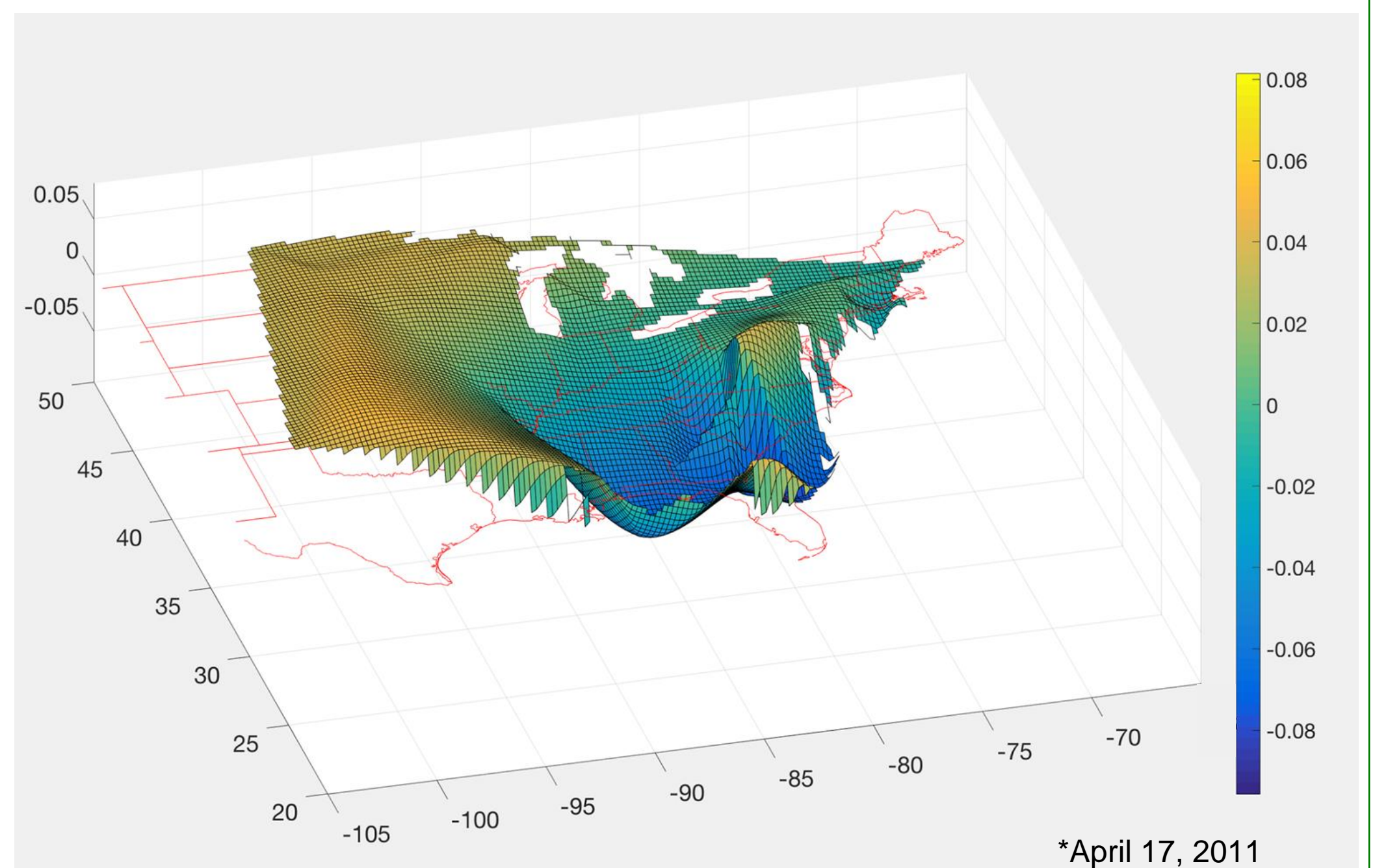
Methods

- A script was implemented to find, import, and sort the FDR data into variables.
- The voltage angle data was then unwrapped using the “unwrap” function, and its oscillations were isolated with the memd function.
- The “griddata” function was used to interpolate and generate a mesh from the frequency data.
- A coastline was then loaded and subtracted from this grid, leaving behind a geographic 3D contour map
- Finally, the “surf” function was used within a FOR loop to animate the event, assigning each tenth of a second of the real time event to a new frame.

Program Summary



Sample Voltage Angle Plot*



Analysis

- 3D animating the data allowed us to easily find the location and time of the disturbance.
- Propagation speed in miles per second can be estimated using the formula, $P_s = D / (T_a - T_e) * .1$ where D is distance in miles between the event and arrival location, T_a is the time of arrival, and T_e is the time of the event.
- Data visualization can reveal which regions of the power grid are more susceptible to instability than others.

Conclusions

Using 3D animation to analyze the frequency and angle data is superior to the 2D methods available prior. The merits include the ability to easily see when and where an event occurred, as well as estimate the propagation speed of a disturbance. The 3D method also makes it easy to observe trends such as major oscillation regions.

Acknowledgements

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