Results Visualization of Contingency Analysis

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Early in my career as a planning engineer, I was sometimes subjected to stories from the more seasoned planners about the days of punch cards and mainframes. They would talk about the difficulty of setting up a simulation for a single, small powerflow scenario, and the thrill of coming to work the next morning to find that their job had successfully run and produced 10 or 12 lines of output. I didn’t have much time for their stories. I was too busy running hundreds of thousands of contingencies with my laptop on a model of the entire Eastern Interconnect, while simultaneously processing emails and catching up on Facebook.

It turns out that programs have become extremely good at producing lots of data very quickly. This goes for our PSS® suite as well. However, our brains have not undergone the same evolution since those days of punch cards and 10 lines of output. So, why do we need so much more data in the first place? It’s because we are maintaining larger, more constrained and more reliable systems, while also dealing with an ever-growing set of regulatory and legal requirements. In addition, we’re doing all this with fewer engineers.

For the most part, we have coped with these developments by sorting, filtering, and rearranging our data in tabular format, but I believe we have reached a tipping point where that is no longer going to cut it. The size and complexity of our models is such that we can’t get away with looking at individual numbers on a spreadsheet anymore. We need to think in terms of trends, relationships and proportions. This is what the RAV (Results Analysis and Visualization) Module is all about.

With RAV, we can start to venture out of the austere world of spreadsheets to a place where we can draw pictures with our data, and a picture is worth a thousand rows on a spreadsheet. These pictures can tell us stories about our results that would be very difficult or impossible for us to understand from a table of numbers. RAV lets us use visual elements like size, shape, position and color to aggregate the results visually, while still giving us access to the underlying data and the ability to drill down into the areas of focus.

Below is an example of the traditional output from PSS®E AC Contingency analysis for branch overloads. Each row contains information on the monitored branch, the contingency and the magnitude of the overload.
This is just one page out of hundreds of pages of this tabular data. How do I make sense of all of it? How do I find the 10 or 12 rows that I actually care about? Let’s see what this same dataset looks like in RAV. In fact, let’s not limit ourselves to a single AC Contingency run, but include four sets of contingency results for different basecases. This is the result:
In this example, I have assigned visual markers to the data that let me mentally consume hundreds of pages of data at a glance. Data for each branch is plotted using shape to denote the basecase, color for the area, size for the average loading and y-position for the maximum loading. Instantly, I see a cloud of results with the branches of interest floating to the top. The large markers that are near the top represent branches with both high average and high maximum loadings. These are the branches I want to focus on. To drill down, I can click an individual marker to get detailed information about the overload magnitudes for that particular branch, or I can select a set markers that can be used to develop additional visualizations for more detailed metrics. All of this was done by dragging and dropping data field names into a sandbox and fine-tuning the visualization behavior.

![Image](image.png)

Figure 3 - Additional RAV Visualization Examples

RAV has several built-in templates that can be used as-is or customized to work best with your data. RAV can also be used without a template to create completely customized views. As RAV matures, more templates will be added and more result types will be supported (PV/QV and dynamics for example). RAV is a very open-ended product whose capabilities will grow and evolve as new ways of visualizing these results are discovered.

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