History of OpenDSS

Feb 5, 2015

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The *DSS* (for Distribution System Simulator) was initially developed at Electrotek Concepts to support consulting and research analysis of distributed generation (DG) on utility power distribution systems. Development began in April 1997 by Roger Dugan. Development accelerated in the Summer when Tom McDermott joined the effort and we started to see value from using the program in engineering projects.

The main discovery that triggered the development of the program was that we were not getting the right answer simulating the impacts of DG by studying only one point it time, as was, and still is, common in distribution planning. Therefore, we designed a program that would do time-series simulations very efficiently. We also wanted a program that could represent nearly any circuit condition that can occur on distribution systems. This was accomplished by combining circuit modeling ideas from Electrotek’s harmonic analysis tool and with lessons learned from developing a power quality analysis tool for EPRI a few years earlier. An entirely new program was developed extensively using object-oriented programming techniques.

Having come to the realization that it was not possible to write a program that would be able to do everything utility distribution planners would want to do, we wanted to provide an interface for users to write a custom algorithm in the language of their choosing to do what they wanted to do. Since the vast majority of utility distribution engineers use the Microsoft Windows platform, we settled on Microsoft’s COM interface for this feature. Many students and consultants take advantage of this feature to drive the OpenDSS simulation from MATLAB, from the “Cloud”, and even the virtually omnipresent Microsoft Office.

In 2004, EPRI acquired the program from Electrotek. It was used for harmonics studies as well as DG studies and numerous miscellaneous engineering studies until the beginning of 2008. Then the growth of solar PV generation and wind generation created a demand for programs to perform sequential-time power flow studies. The program was largely used for proprietary studies for EPRI and other clients of the power systems studies group. There was little effort to make it available to others.

In late 2007, those in the industry outside of EPRI who knew about the program either from studies or from having used the program at Electrotek began to call for EPRI to make the program available. After considering the cost of making the DSS a commercial product and maintaining it, the decision was to make it open source and freely available to encourage the advancement of tools to support grid modernization efforts. This was judged to be more beneficial to our members in the long run than a moderately-expensive commercial software tool that might take $1M to develop. There were many advocates in EPRI for the open-source approach, as there are today, which was a departure from the usual way EPRI distributes software. It was posted as open source on Sourceforge.net in September 2008 and re-christened OpenDSS.

OpenDSS is basically a circuit solution engine with a rudimentary text-based scripting interface. Of course, many utility users expect a full-featured graphical user interface. Instead of using member funds to develop such features, the idea was let the open-source community develop such “extras” for the program. It has taken a while, but we are beginning to see this come to fruition with users developing cloud applications and some very interesting advanced applications coming from the academic community.

The EPRI Green Circuits project was the first project to make extensive use of OpenDSS. Several features were added to the program to allow it compute losses in various ways. Others around the world have picked up on this capability and recommend its use to compute distribution losses.

This accelerated the interest in the program considerably, but perhaps the greatest acceleration in the use of the program occurred with some in the National Labs and a major manufacturer discovered it could simulate solar PV characteristics very efficiently. This caused a relative explosion in the number of downloads of the program as word spread. At the end of 2013, it was determined there had been over 20,000 downloads from 172 nations. This might make OpenDSS the most widely-distributed EPRI program ever. Most were from the US, with China and the UK not far behind. The program has proven more popular than expected in the Pacific Rim nations and in parts of Europe.

This publicity opens doors in places where EPRI would otherwise be virtually unknown. Being free, academics around the world have downloaded and used the program extensively despite its rudimentary user interface. Most graduate students are accustomed to scripting interfaces, whether writing in MATLAB or Python. The EPRI logo on the main window remind the users of its origin. I have literally been around the world making invited presentations on the program and questions come into the Discussion Forum almost daily from all over the world. We also have users who have mastered the program conducting training courses in places like Malayasia. We have developed a very strong following in such varied places as Bogota, Columbia, Manchester, UK, and various places in China. It is also well-known in parts of Italy where there are several users and in France where it is part of our joint research with EDF.

The program also makes connections between our utility members and universities in their service territories with which they can partner for research. In 2010, we conducted OpenDSS workshops to which universities were also invited. Soon thereafter we began to see papers presented at conferences with OpenDSS prominently displayed and featuring familiar-looking diagrams that the program produces. It is now standard procedure to encourage utilities to invite local universities to these workshops.

It looks like the next topics the industry is interested in tackling are microgrids, co-simulation of power and communications networks, various Integrated Grid topics, Distribution Management System (DMS)/ Distribution Automation (DA) simulation, and parallel processing. There is no shortage of things to do.