



ZÁPADOČESKÁ
UNIVERZITA
V PLZNI



Software pro řešení chodu ES

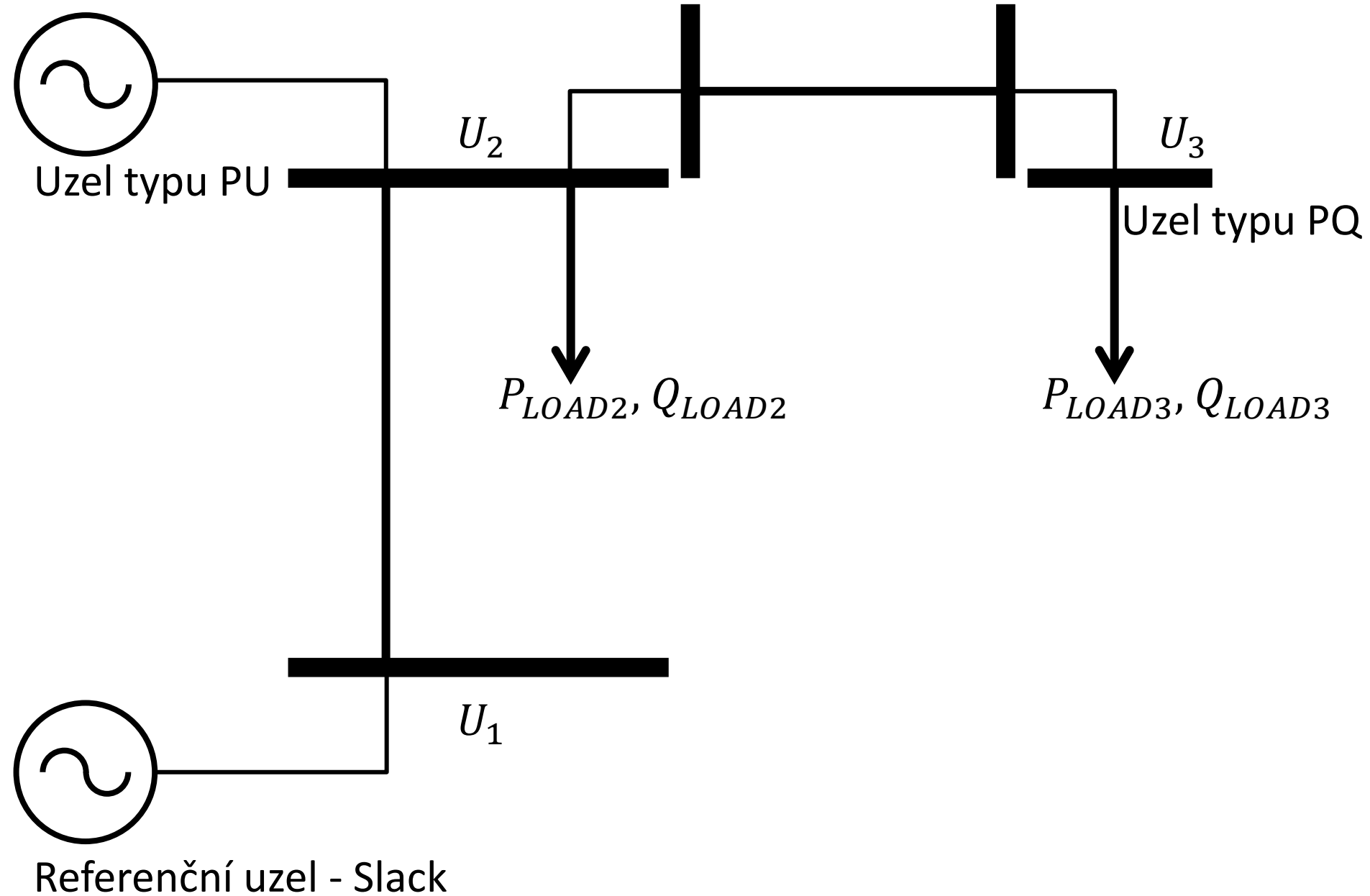
PSAT

GridCal

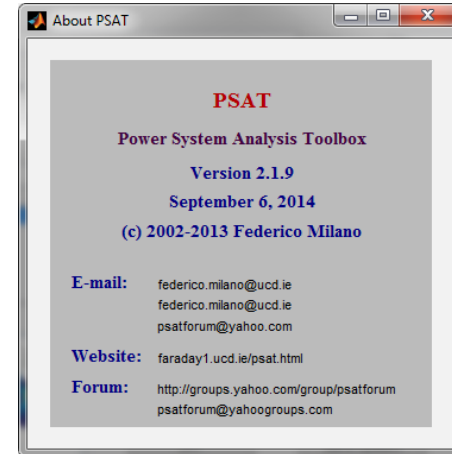
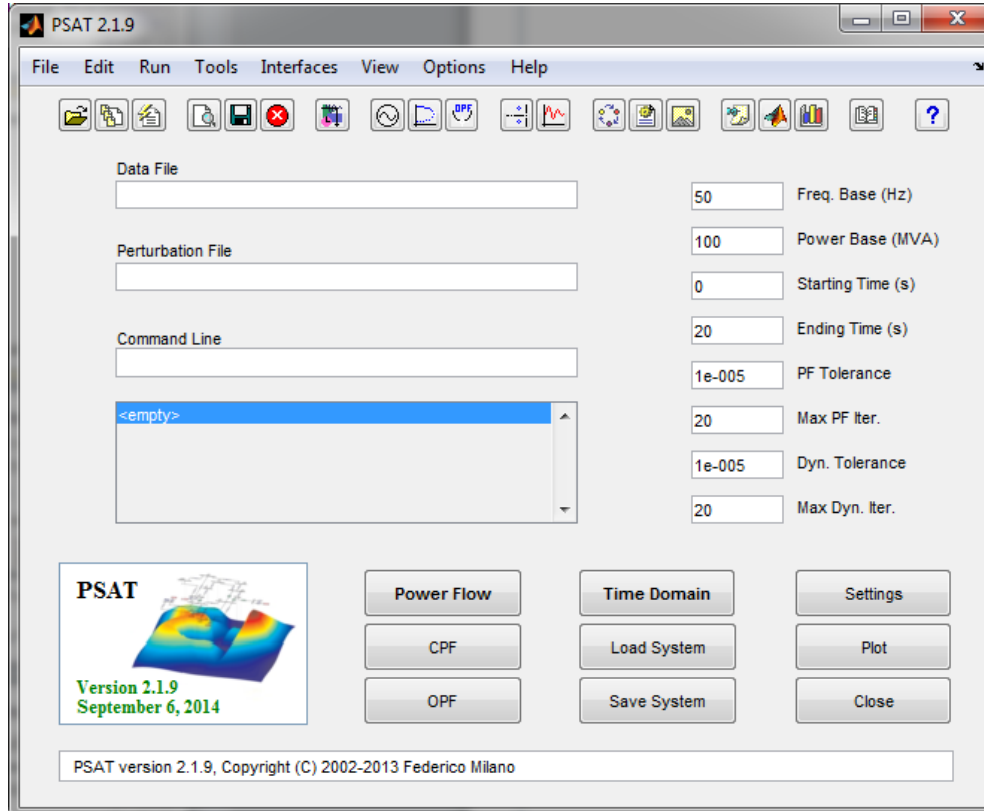
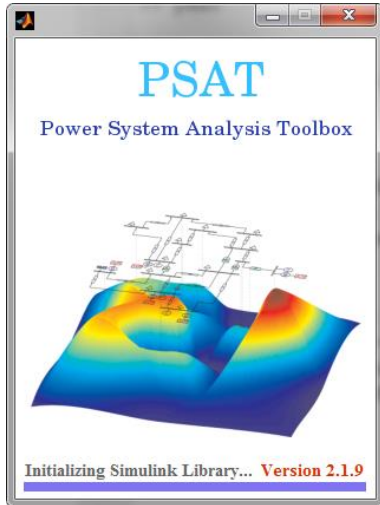
MatPower

doc. Ing. Karel Noháč, Ph.D.

Plzeň 2017

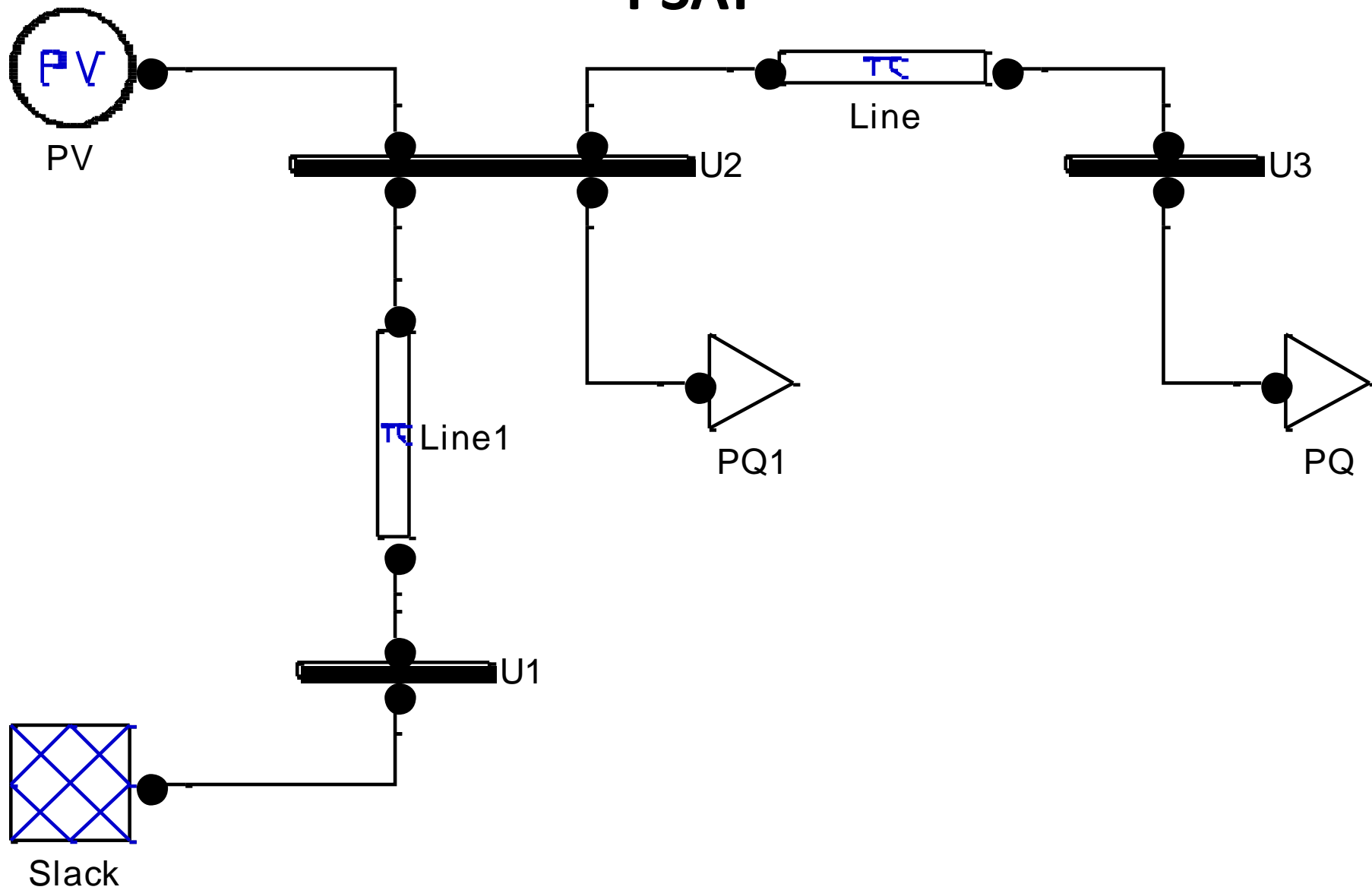


PSAT

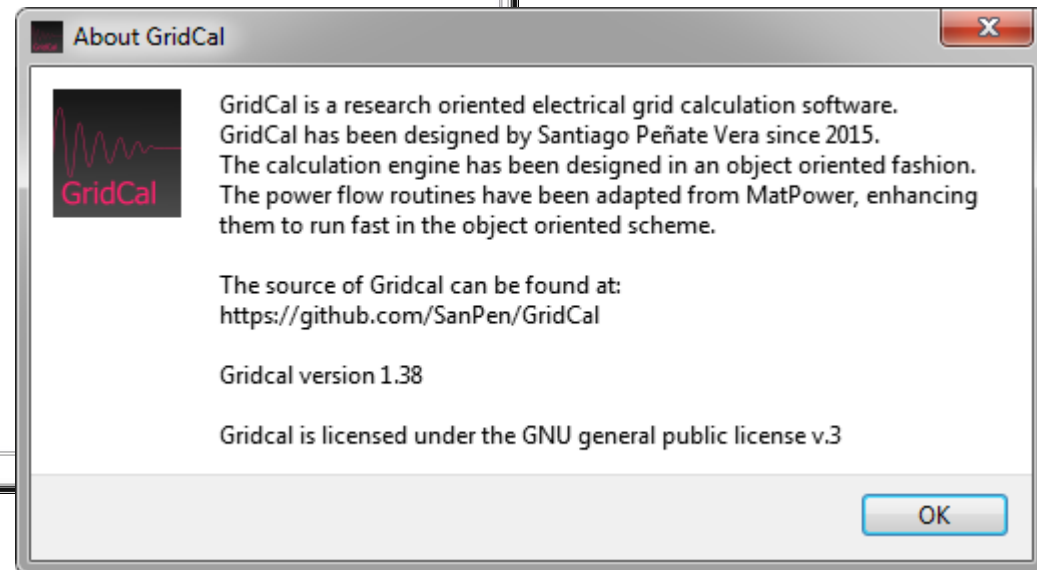
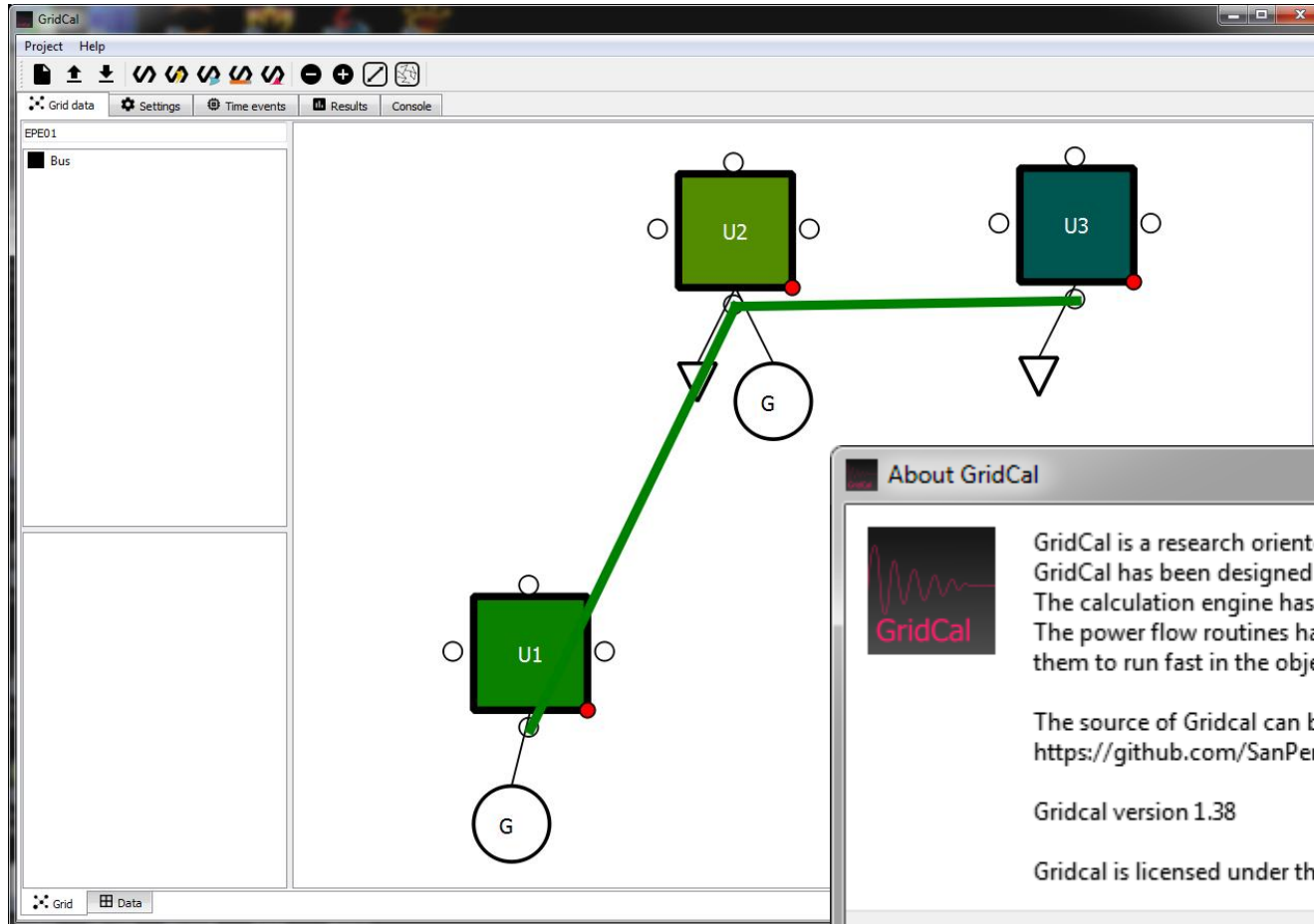


<http://faraday1.ucd.ie/psat.html>

PSAT

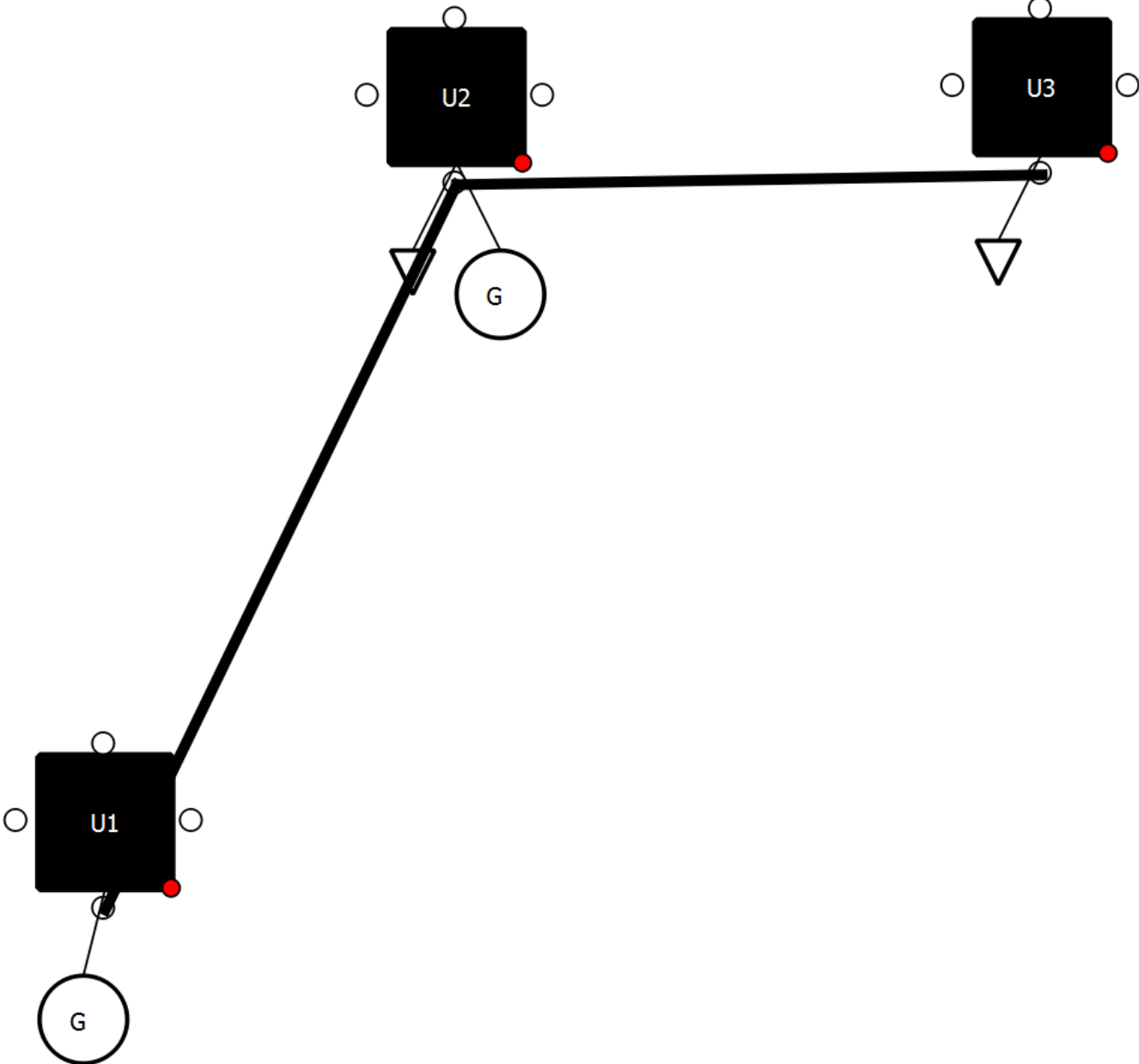


GridCal

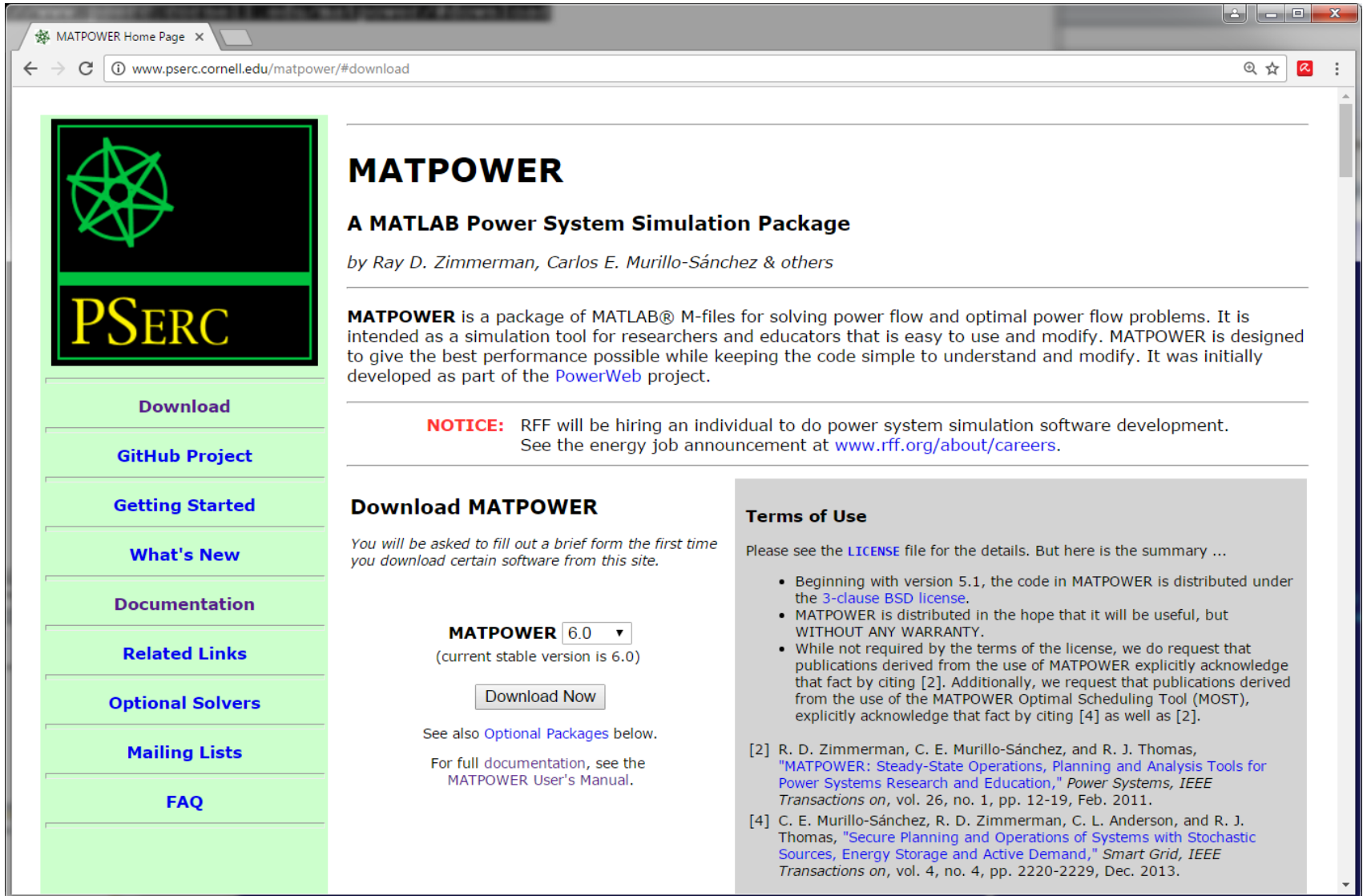


<https://github.com/SanPen/GridCal>
<https://pypi.python.org/pypi/GridCal>

GridCal



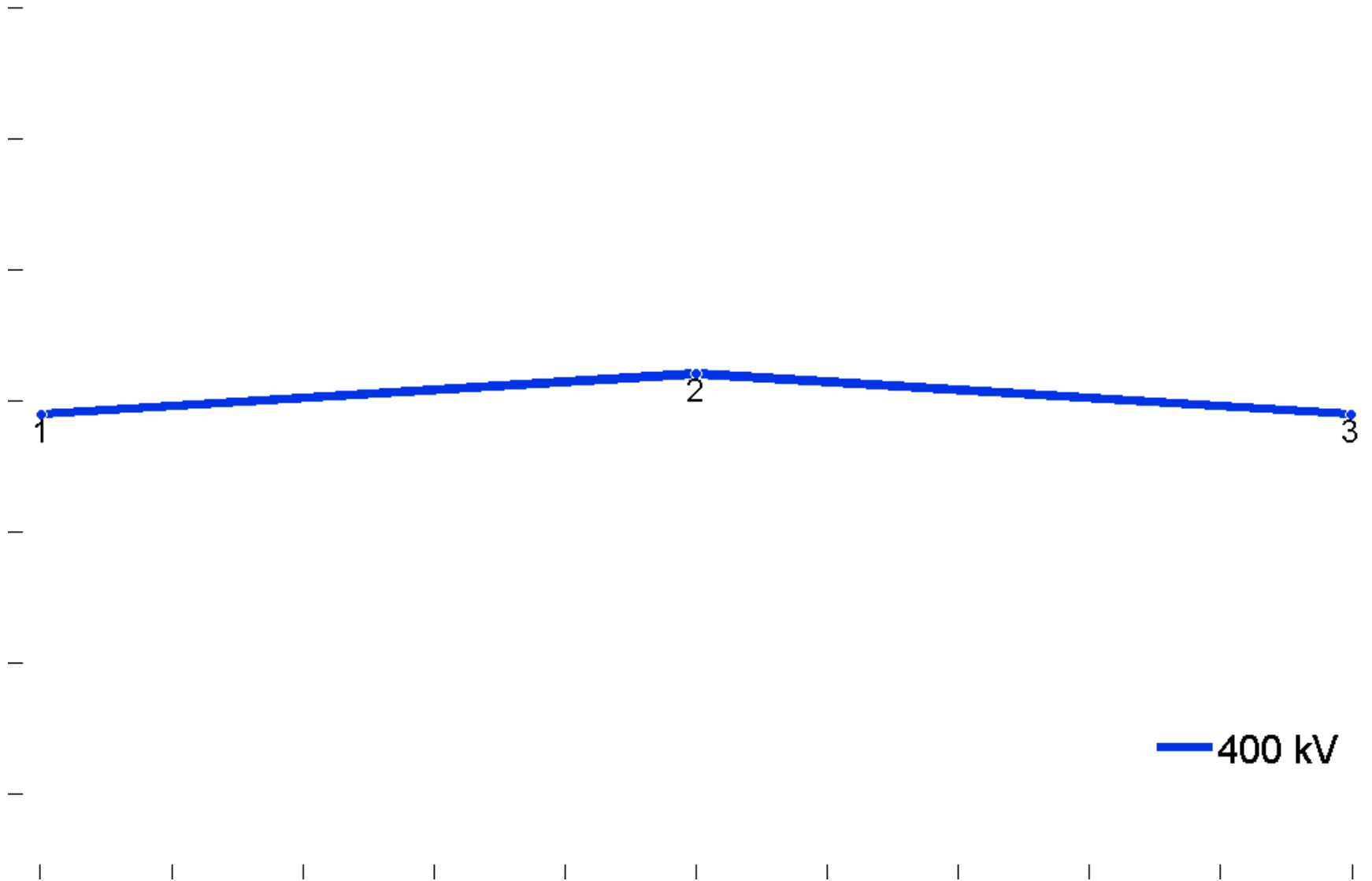
MatPower



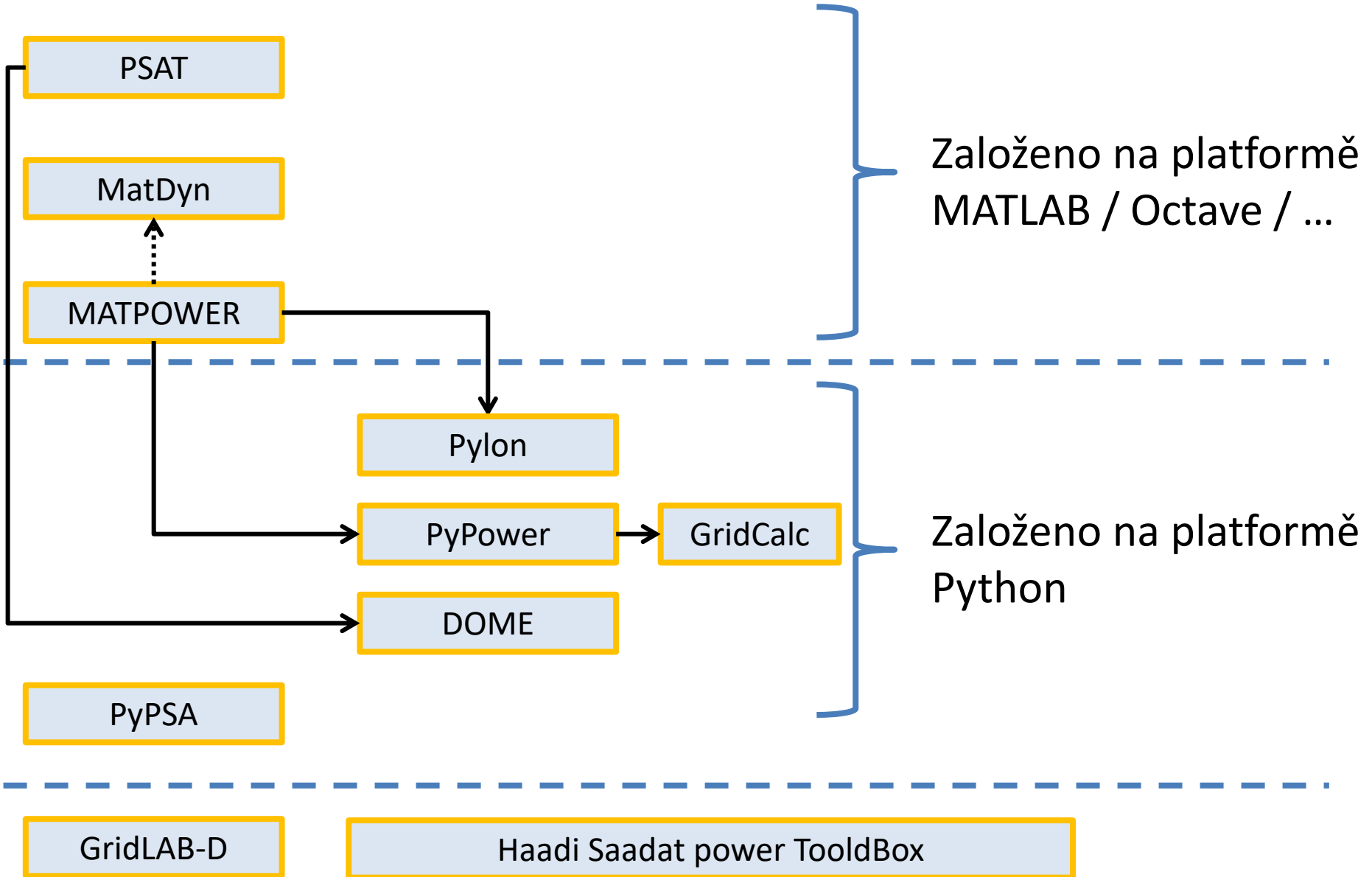
The screenshot shows a web browser window with the address bar displaying `www.pserc.cornell.edu/matpower/#download`. The page features a navigation sidebar on the left with links for Download, GitHub Project, Getting Started, What's New, Documentation, Related Links, Optional Solvers, Mailing Lists, and FAQ. The main content area includes the MatPower logo (a green star-like symbol) and the PSERC logo (yellow text on a black background). Below the logos, the text reads "MATPOWER" and "A MATLAB Power System Simulation Package" by Ray D. Zimmerman, Carlos E. Murillo-Sánchez & others. A "NOTICE" section states that RFF will be hiring an individual for power system simulation software development, with a link to `www.rff.org/about/careers`. The "Download MATPOWER" section includes a dropdown menu for the version (6.0) and a "Download Now" button. A "Terms of Use" section provides a summary of the license and lists two references: [2] R. D. Zimmerman, C. E. Murillo-Sánchez, and R. J. Thomas, "MATPOWER: Steady-State Operations, Planning and Analysis Tools for Power Systems Research and Education," *Power Systems, IEEE Transactions on*, vol. 26, no. 1, pp. 12-19, Feb. 2011. and [4] C. E. Murillo-Sánchez, R. D. Zimmerman, C. L. Anderson, and R. J. Thomas, "Secure Planning and Operations of Systems with Stochastic Sources, Energy Storage and Active Demand," *Smart Grid, IEEE Transactions on*, vol. 4, no. 4, pp. 2220-2229, Dec. 2013.

<http://www.pserc.cornell.edu/matpower>

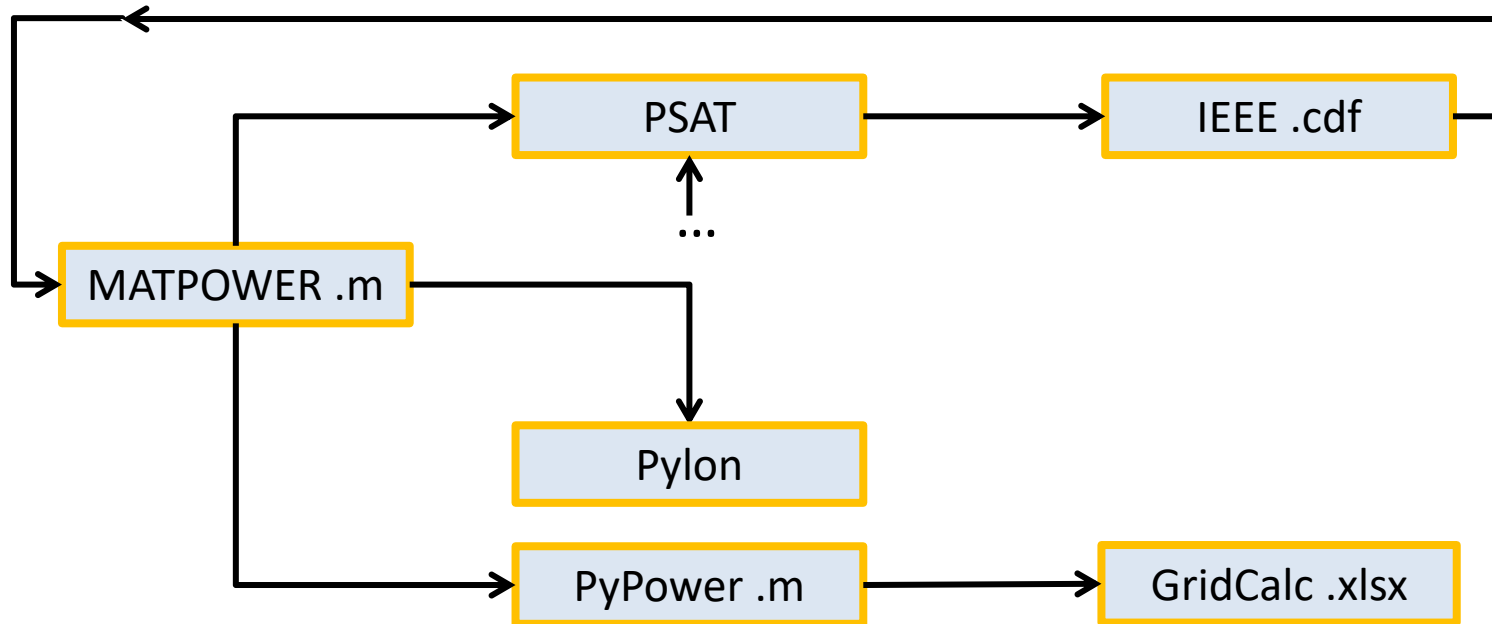
MatPower



Vývoj otevřených aplikací pro analýzu chodu ES



Formáty souborů otevřených aplikací pro analýzu chodu ES



PSAT

Bus	V [p.u.]	phase [rad]	P gen [p.u.]	Q gen [p.u.]	P load [p.u.]	Q load [p.u.]
U1	1	0	-0.39558	-1.4079	0	0
U2	1.0125	0.002578	5	1.7514	0.5	0.2
U3	0.93671	-0.27676	0	0	4	1

LINE FLOWS

From Bus	To Bus	Line	P Flow [p.u.]	Q Flow [p.u.]	P Loss [p.u.]	Q Loss [p.u.]
U2	U3	1	4.1028	0.41824	0.10278	-0.58176
U1	U2	2	-0.39558	-1.4079	0.001644	-0.2748

LINE FLOWS

From Bus	To Bus	Line	P Flow [p.u.]	Q Flow [p.u.]	P Loss [p.u.]	Q Loss [p.u.]
U3	U2	1	-4	-1	0.10278	-0.58176
U2	U1	2	0.39722	1.1331	0.001644	-0.2748



PSAT

GLOBAL SUMMARY REPORT

TOTAL GENERATION

REAL POWER [p.u.]	4.6044
REACTIVE POWER [p.u.]	0.34345

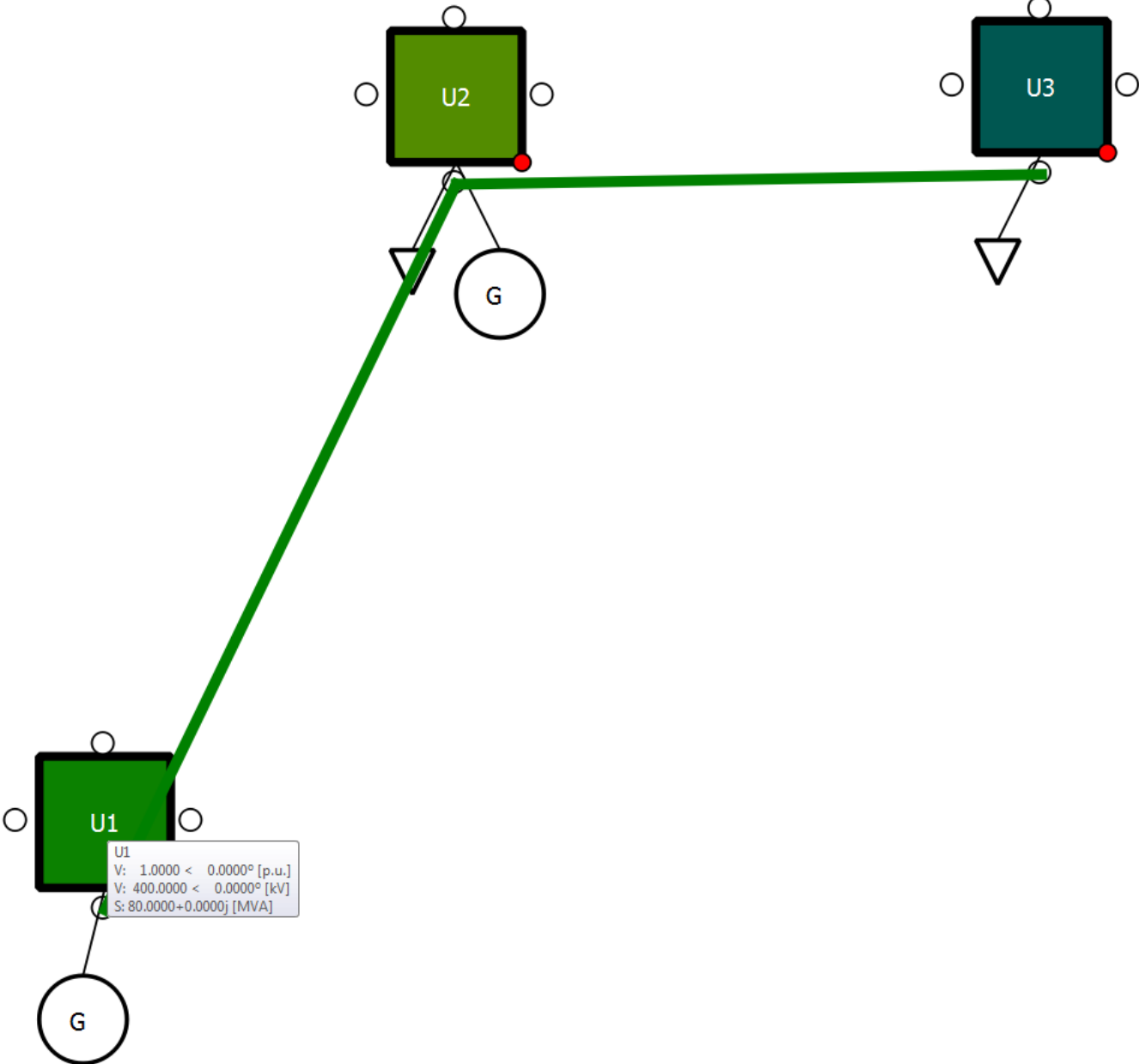
TOTAL LOAD

REAL POWER [p.u.]	4.5
REACTIVE POWER [p.u.]	1.2

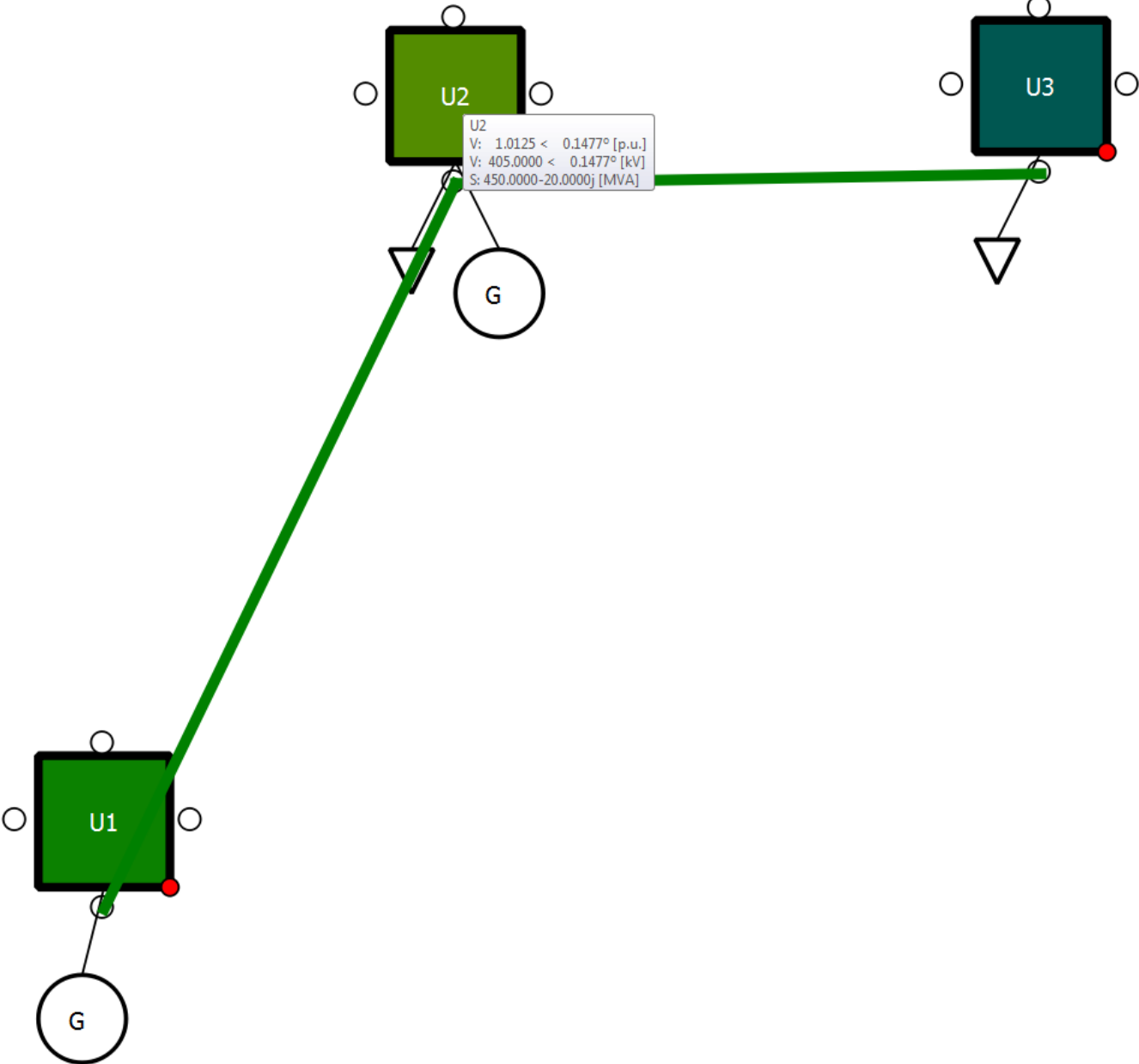
TOTAL LOSSES

REAL POWER [p.u.]	0.10442
REACTIVE POWER [p.u.]	-0.85655

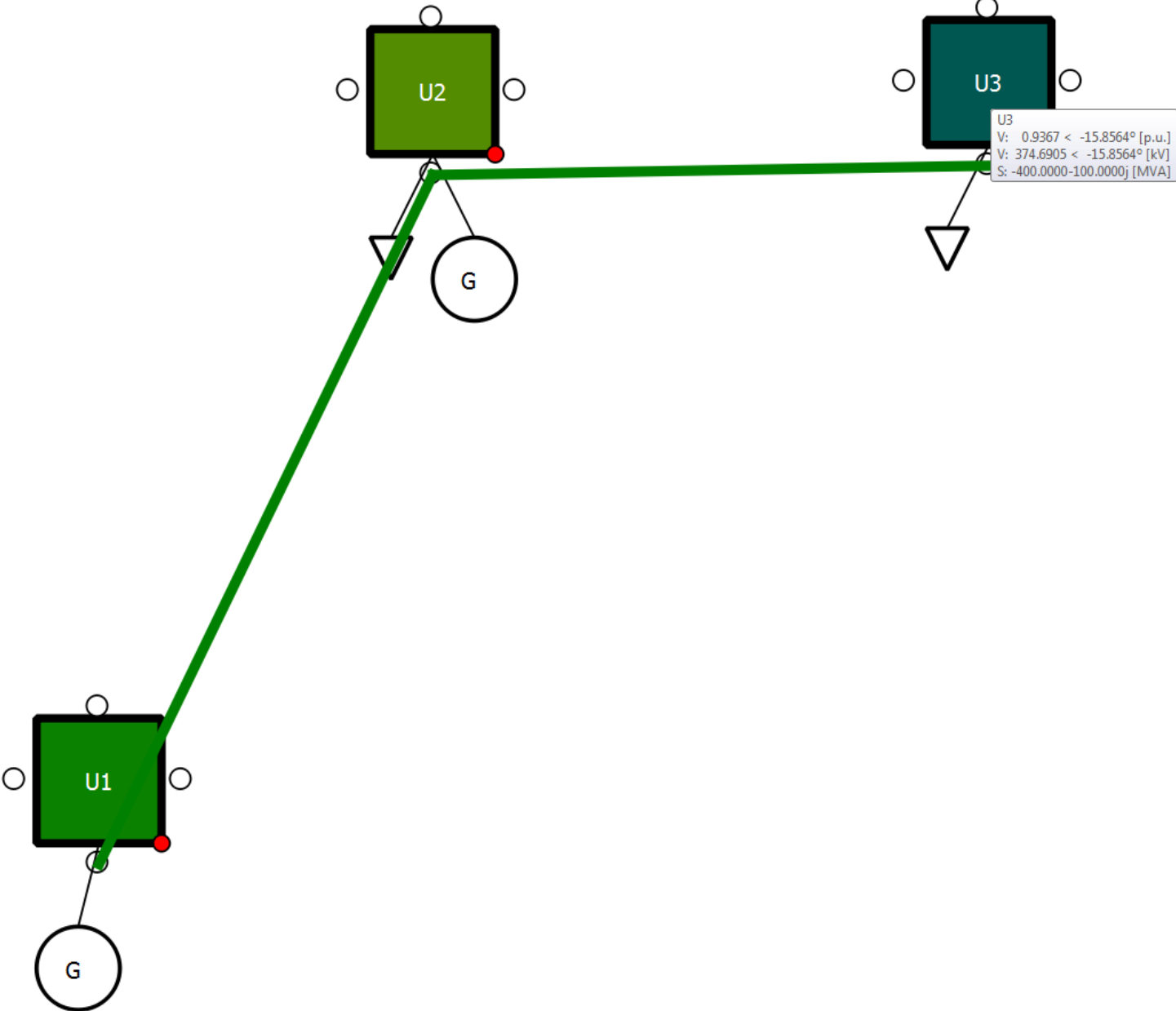
GridCal



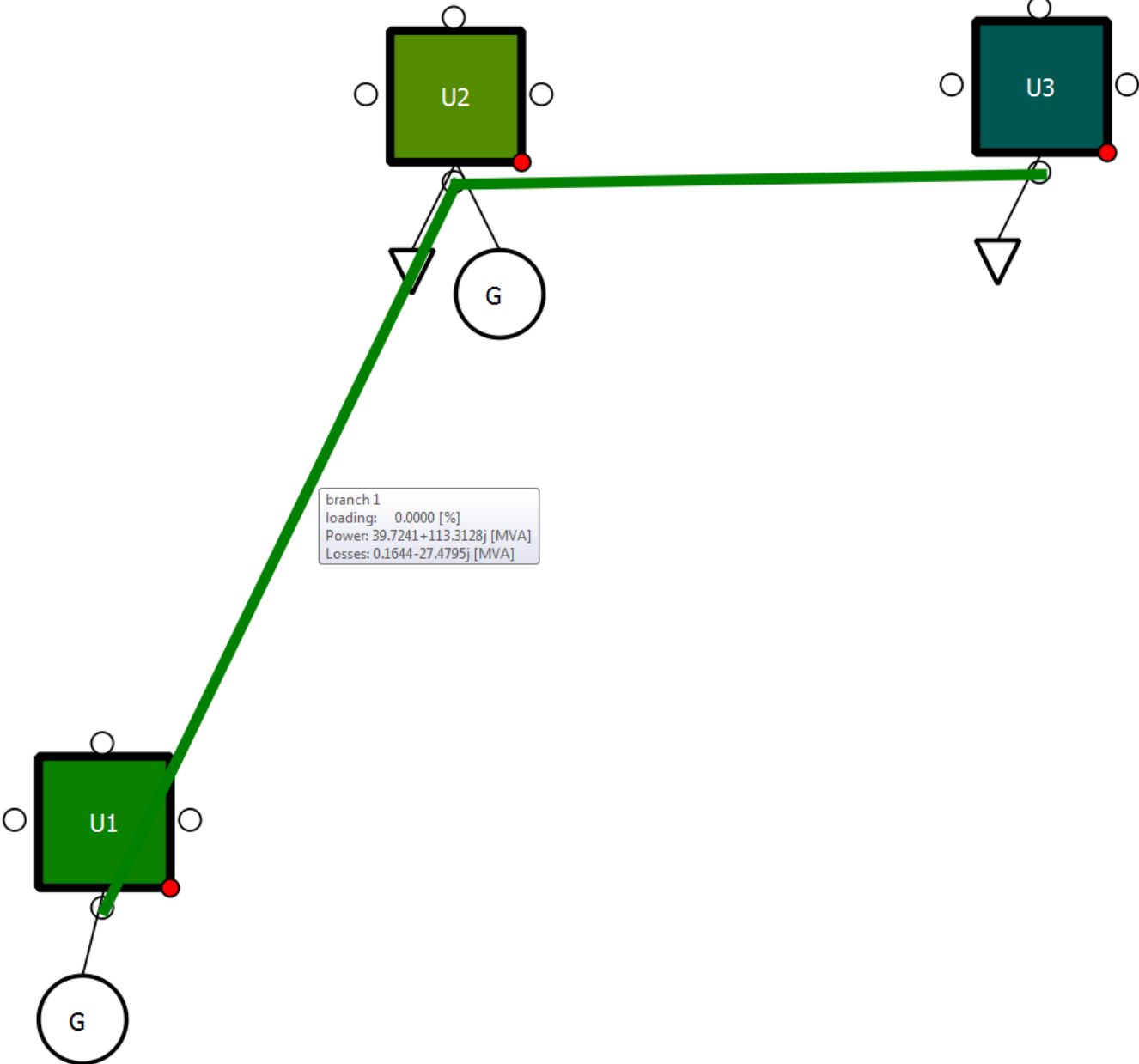
GridCal



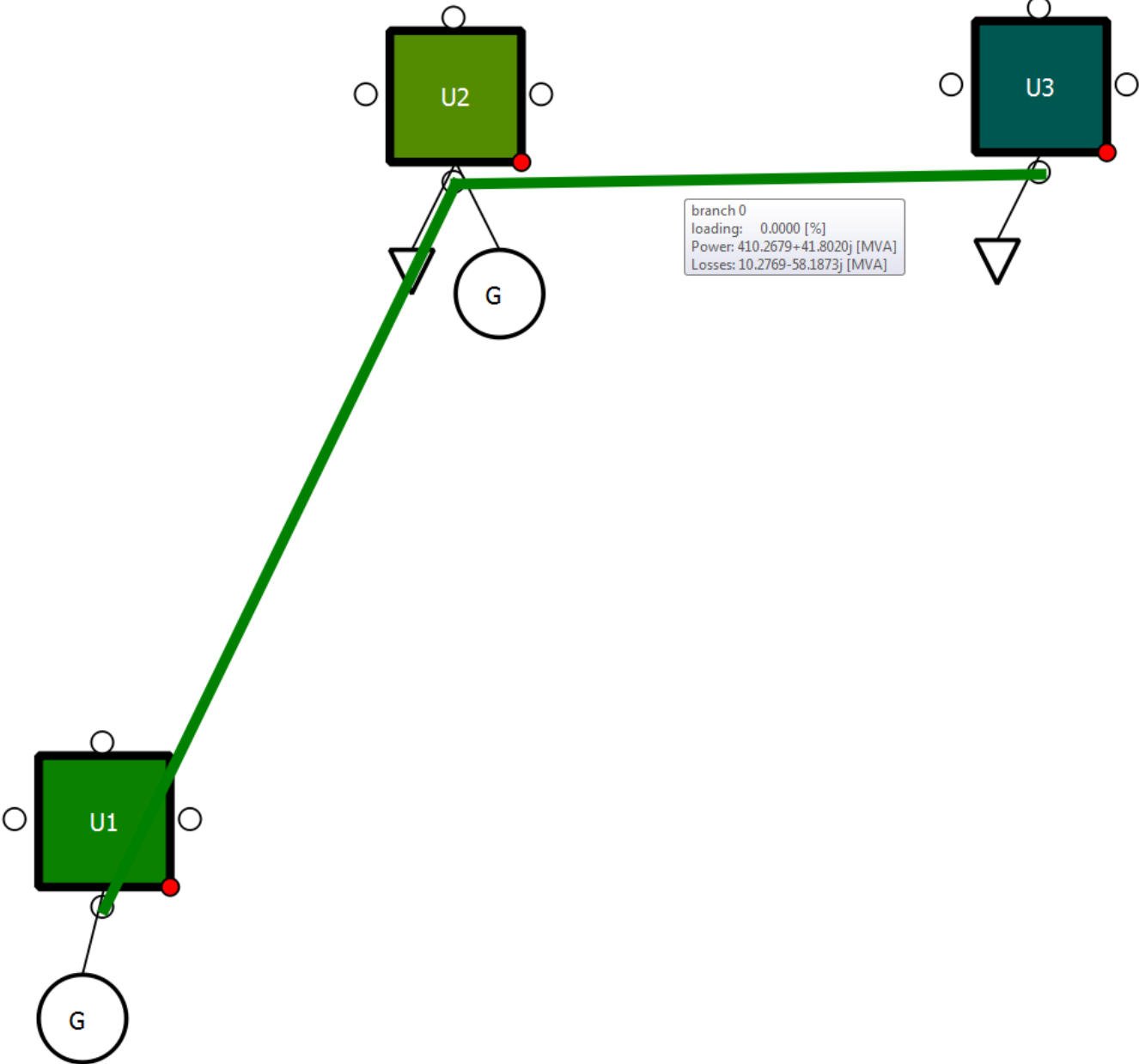
GridCal



GridCal



GridCal



GridCal

Bus voltage

U1 (1+0j)
U2 (1.01249663514+0.00261033065899j)
U3 (0.901083399485-0.255939068324j)

Bus voltage

Magnitude

Angle

U1
U2 1.0125 0.002578107
U3 0.936726267 -0.276746265

Branch power

branch 0 (410.267890265+41.8020313205j)
branch 1 (39.7241365202+113.312804972j)

Branch power 2

branch 0 -399.9909823
branch 1 -39.55969914

Branch losses

branch 0 (10.2769079851-58.1872861404j)
branch 1 (0.164437384923-27.4795175534j)

Bus load

U1 0 0
U2 50 20
U3 400 100

Bus generation

U1 -39.55969914 -140.7923225
U2 499.9920268 175.1148363
U3 0.00901772 0.010682539

Total generation

460.4413454 34.33319631

Total load

450 120

Total losses

10.44134537 -85.66680369

MatPower

How many?		How much?	P (MW)	Q (MVAr)
Buses	3	Total Gen Capacity	780.0	-250.0 to 400.0
Generators	2	On-line Capacity	780.0	-250.0 to 400.0
Committed Gens	2	Generation (actual)	460.4	34.3
Loads	2	Load	450.0	120.0
Fixed	2	Fixed	450.0	120.0
Dispatchable	0	Dispatchable	-0.0 of -0.0	-0.0
Shunts	0	Shunt (inj)	-0.0	0.0
Branches	2	Losses (I ² * Z)	10.44	121.59 (85.66)
Transformers	0	Branch Charging (inj)	-	207.2
Inter-ties	0	Total Inter-tie Flow	0.0	0.0
Areas	1			

	Minimum	Maximum
Voltage Magnitude	0.937 p.u. @ bus 3	1.013 p.u. @ bus 2
Voltage Angle	-15.86 deg @ bus 3	0.15 deg @ bus 2
P Losses (I ² *R)	-	10.28 MW @ line 2-3
Q Losses (I ² *X)	-	119.91 MVAr @ line 2-3

MatPower

Bus Data

Bus #	Voltage		Generation		Load	
	Mag (pu)	Ang (deg)	P (MW)	Q (MVA _r)	P (MW)	Q (MVA _r)
1	1.000	0.000*	-39.56	-140.79	-	-
2	1.013	0.148	500.00	175.14	50.00	20.00
3	0.937	-15.857	-	-	400.00	100.00
Total:			460.44	34.34	450.00	120.00

Branch Data

Brnch #	From Bus	To Bus	From Bus Injection		To Bus Injection		Loss (I ² * Z)	
			P (MW)	Q (MVA _r)	P (MW)	Q (MVA _r)	P (MW)	Q (MVA _r)
1	2	3	410.28	41.82	-400.00	-100.00	10.278	119.91 (58.18)
2	1	2	-39.56	-140.79	39.72	113.31	0.164	1.68 (27.48)
Total:							10.442	121.59 (85.66)