Topics for Today:

- Course Info:
  - Web page: [http://www.ee.mtu.edu/faculty/bamork/ee5220/](http://www.ee.mtu.edu/faculty/bamork/ee5220/)
  - Book, references, syllabus, more are on web page.
  - Software - Matlab. ATP/EMTP [ License - [www.emtp.org](http://www.emtp.org) ] ATP tutorials posted on our course web page
  - [EE5220-L@mtu.edu](mailto:EE5220-L@mtu.edu) (participation = min half letter grade)

- Term Project - Journal paper analysis - completed by Fri April 8th
- Line Switching
  - Single pole tripping and reclosing
  - Secondary arc interruption
- Lightning - Ch.14
  - Basic characteristics
  - Statistical approach
- Next: insulation coordination - Chapters 15.
SPT - Single-Pole Tripping

Area 1

Area 2

SLG Fault

\[ P = \frac{V_1 V_2 \sin \theta}{X} \]

- Maintain P+Q flows thru intact phaser.
- Don't "lose" system tie due to large "Standing V angle" as can happen w/ 3-pole trip/recl.
Capacitive coupling B-A and C-A induces voltage on A which continues to provide a "secondary arc current."
Extinquishing Secondary Arc
- Short Lines: Self-extinguishing
- Longer Lines: Switch (High-speed)
- Grounding
- Resonant Grounding

Gnd Swi.
Resonant Grounding

Parallel L-C impedance path
that is resonant.
**STATISTIC SWITCH**

Switch type: Independent

- Open/Close:
  - Open
  - Close

T: 0

Dev: 0

le: 0

Distribution:
- Uniform
- Gaussian

Order: 0

Label:

Output:
- 0: No

Hide

Lock

**Help Viewer**

**Name**: SW_STAT - Statistic switch, Generalized object.

**Card**: SWITCH

**Data**: Special handling.

- Distribution: Select uniform or Gaussian distribution.
  - If IDIST=1 under ATP/Settings/Switch only uniform is possible.
  - If switch closes or opens, Current margin available for opening switch.

**T** - Average switch opening or closing time in [sec.]

**Dev** - Standard deviation in [sec.]

For Slave switches this is the deviation of the delay.

**le** - Switch opens at a time T+le and the current through the switch is less than le.

Select also the switch type:

- **Indep**: Two nodes
- **Target**: Two nodes, 'TARGET' punched. Only one is allowed (not tested)
- **Slave**: Four nodes. Specify node names of Master switch.

The 'a', 'b', and 'c' nodes of the objects adopt the switch type setting.

Node:
- **SW_F**: Start node of switch.
- **SW_T**: End node of switch.
- **USA_F**: Start node of the Master switch
- **USA_T**: End node of the Master switch

**RuleBook**: V.3 D.1
Switch - Statistical

\[ \bar{x}, \sigma, \sigma^2 \]

\[ \bar{x} = T \]

Master - Slave

Upon Completion -

\[ V_{max} \]

\[ V \rightarrow \text{Frequency} \]
Statistical Sims

1 → 1000

N

V

V_{\text{damage}}

V_{\text{pk}}

\text{Prob that } V = V_{\text{damage}}

\text{Histogram of peak overvoltages}

(1000 cases) P_1

0 \rightarrow V_{\text{min}}

V_{\text{max}}
Best visualization:

% risk

100%

Vmax

Vdamage

0

Vmin