ECE 524

TRANSIENTS IN POWER SYSTEMS

SESSION no. 36
New Homework
  - due April 25
  - overlines
    - calculate new constants
      using ATP/EMTDC
    - simulate in a system
  - posted later today
Frequncy dependent (J, M, etc).

- Transposed, so specially model matrix

- Distributed parameter model (not uniformly)

- Coupled pl model (again 10 sections or so)

Similar to overhead lines

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Model Options

- Still see short travel times
- Often shorter than overhead lines, so
- T1 and T are no longer T
- Propagation velocity substantially lower

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Cables

Modeling Underground
- Cable constants/cable parameters
  calculations
  - enter geometric information
    and material properties
- Some geometries not supported
  - older distribution cables
Superconducting cables - Triaxial cable
Set up for single core cables

Sheath
Core
Insulation
Armor

Some 30 configurations

Pipe
- for cables vs overhead lines
  - lower $L$ per length
  - higher $C$ per length

\[ L' = \frac{\text{NonLin} \cdot \ln\left(\frac{\text{Distance}}{\text{radius}}\right)}{2 \pi} \]

\[ C' = \frac{2 \pi \varepsilon_0 \varepsilon_r}{\ln\left(\frac{\text{Dist}}{\text{Rad}}\right)} \]
- charging current will be higher per length

\[
\frac{V^2}{X_C} \quad \text{vs} \quad I^2 X_L
\]
DC cables

→ Classical → Line commutated current source converters (LCC, LCCSC)

- Cable insulation must withstand long time periods of either polarity

\[ V_{dc} = \text{constant} \cos(\alpha) \]

- Poles flip for \( \alpha > 90^\circ \)

\( \alpha \in [50^\circ, 170^\circ] \)

Up to 800 kV

(1600 kV pole to pole)
Voltage sourced converter

- Because voltage polarity doesn't change - use X LPE

- Initially only for underground/undersea
Underground, resting on ground, or in air

- Overhead conductors (Class C) - Not in air
- Conducting pipe (Class B)
- A set of single core coaxial cables in a
  cable (Class A)
- An arbitrary configuration of single core coaxial
  cables

Limited to the following cable types:

- Support routine that calculates R, L, and C matrices or modal data
Parameters
ATPDraw Cable

ATPDraw Cable Constants Session 35
EC324

Spring 2016
cable sheath grounding