MANITOBA·HVDC RESEARCH CENTRE

PSCAD

Custom Model Development

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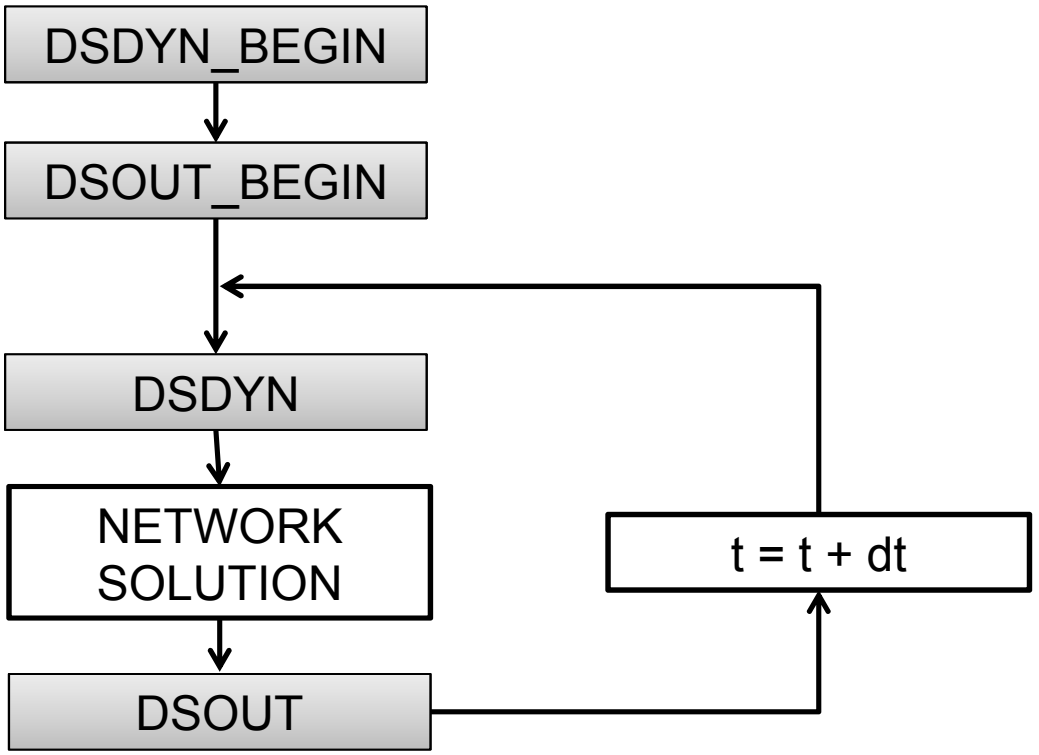
Presentation Content

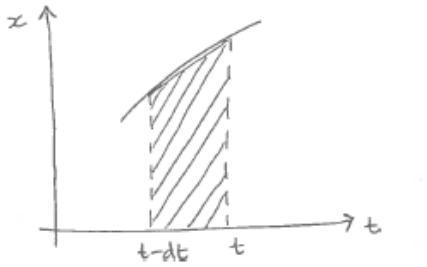
- Program structure of EMTDC
- How electrical circuit components and mathematical blocks are treated
- Numerical solution to differential equation
- Data storage and memory management
- Mathematical block example
- Representation of electrical elements
- Electrical element example

Program Structure



Solving Differential Equations Numerically

- Typically use trapezoidal rule



$$y = \int x\, dt$$

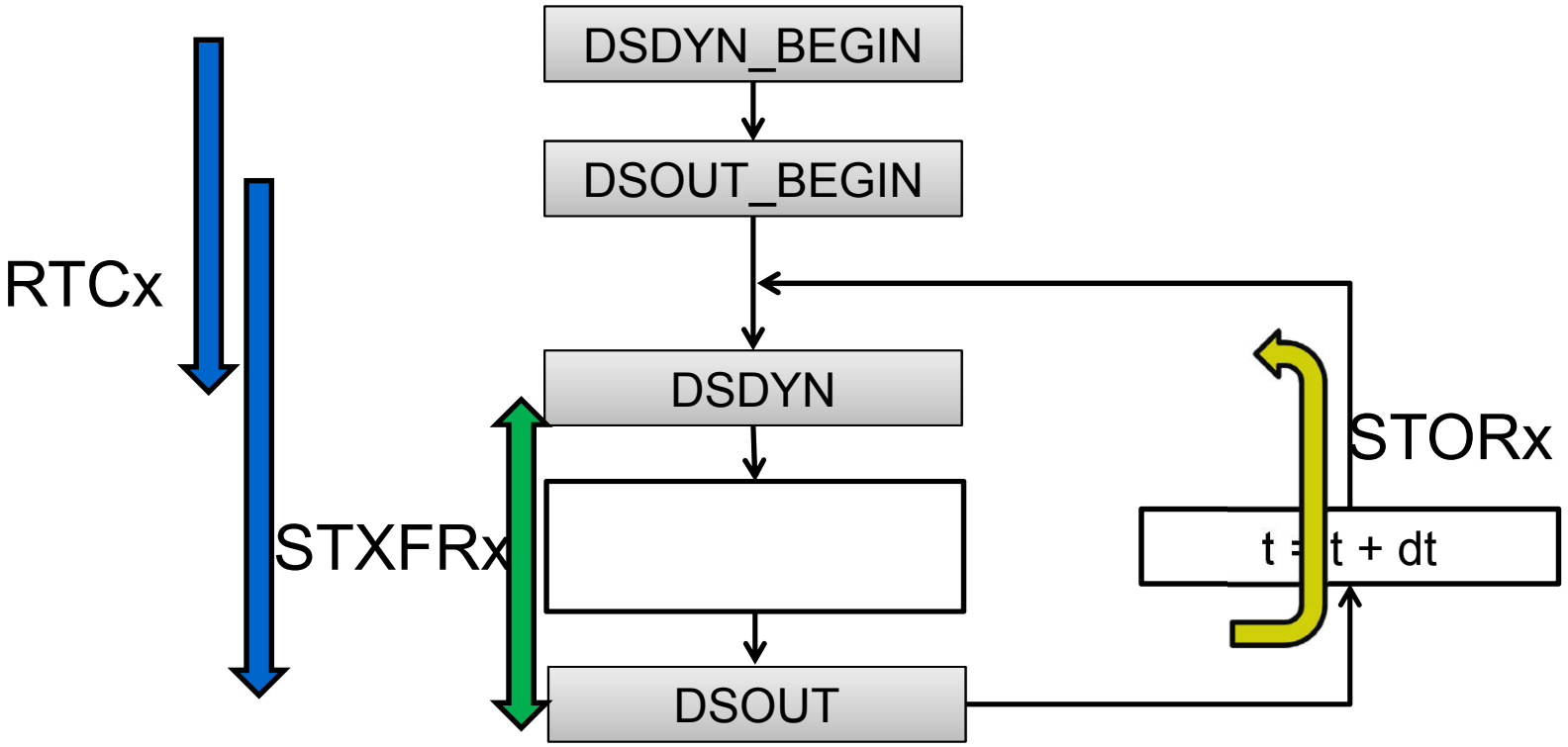
$$y(t) = \mathrm{y}(t \quad dt) + \frac{x(t) + x(t \quad dt)}{2} \quad dt$$

Data Storage & Memory Management

- STORx Arrays
  - Transfer data from time step to time step
- RTCx Arrays
  - Transfer data from DSDYN_BEGIN to DSDYN or DSOUT_BEGIN to DSOUT
- STXFRx Arrays
  - Transfer data from DSDYN to DSOUT or vice versa

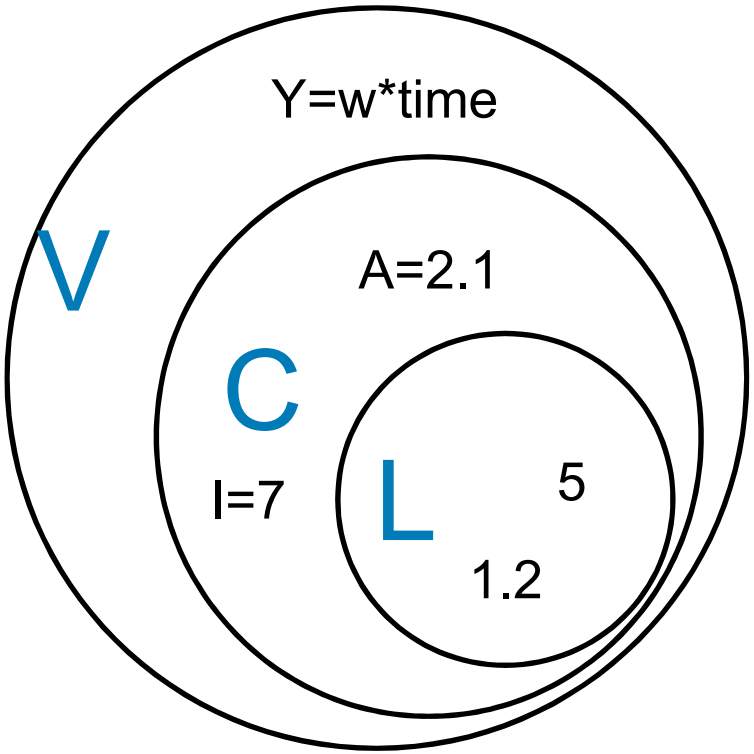
x = Logical, Integer, Floating point, Complex

Data Storage & Memory Management

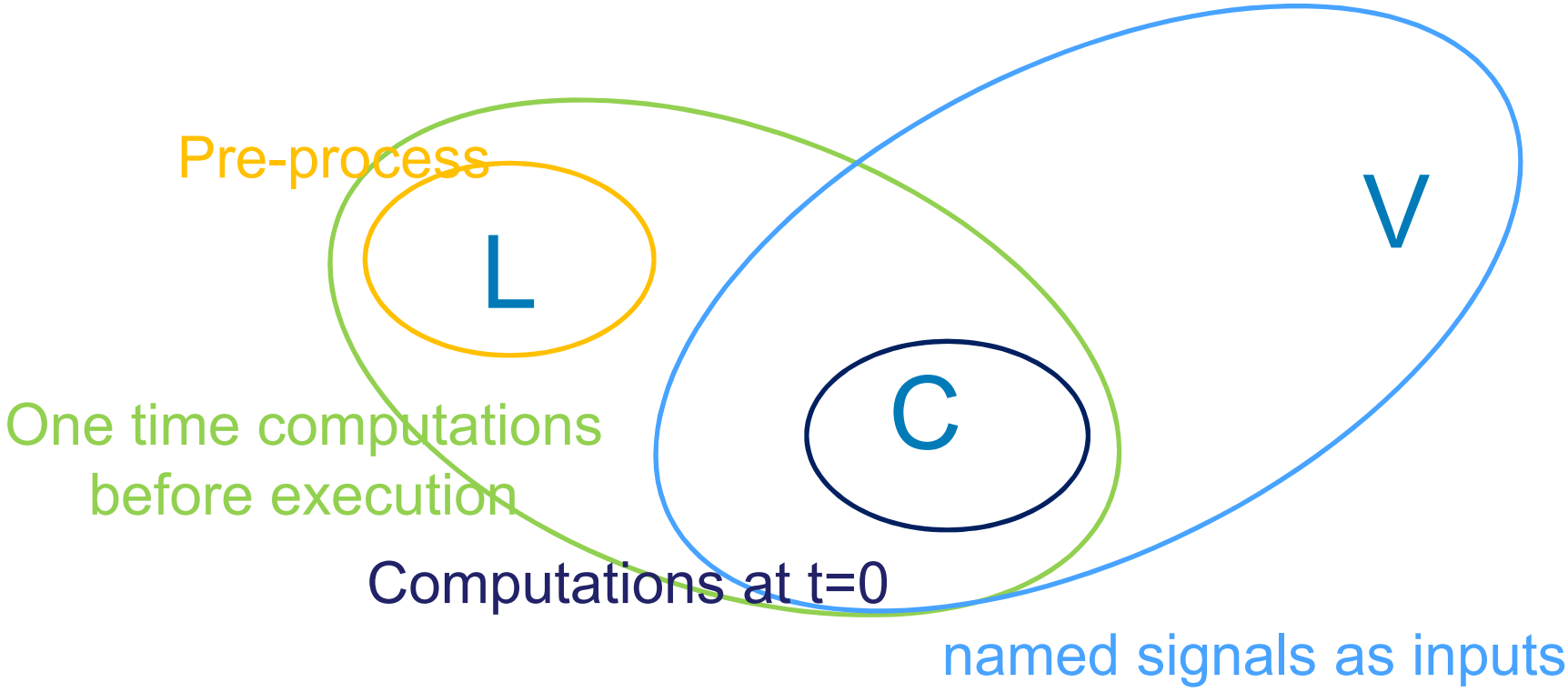


Parameter Data Types

- Literal
  - Could be used for pre-processing
- Constant
  - Could be used in one time computations in _BEGIN routines
  - Could be transferred from a page module parameter
- Variable
  - Executable code could become less efficient compared to other two



Parameter Data Types



Segment Types

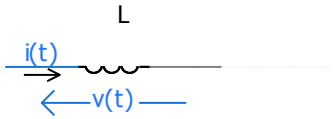
- Branch
  - Electrical branches
- Checks
  - Checks based on literal or choice parameters
- Comments
- Computations
  - Computations based on literal or choice parameters
- Dsdyn/Dsout/Fortran
  - Code written to Fortran routines generated
  - Anything in between #BEGIN and #ENDBEGIN goes to _BEGIN routines
  - "Fortran" segment may go to either Dsdyn or Dsout

Segment Types

- FlyBy
  - FlyBy help text on port connections
- Help
  - Link to a help document
- Matrix-Fill
  - Information on how the matrix will be filled.
    Helps to order the nodes
- Model-Data
  - Information written to data file
- Transformers
  - If transformers are used how they are connected.

Example of an electrical branch
Inductor as a custom component

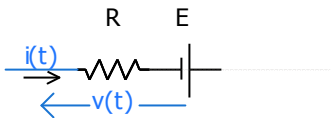
$$v = L\frac{di}{dt}$$



$$\frac{v(t) + v(t \quad dt)}{2} = L\frac{i(t) \quad i(t \quad dt)}{dt}$$

$$v(t) = \frac{2L}{dt}i(t) \quad \frac{2L}{dt}i(t \quad dt) \quad v(t \quad dt)$$

$$v(t) = R \quad i(t) \quad E(t)$$



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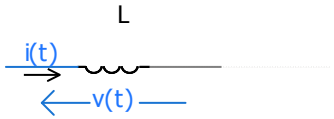
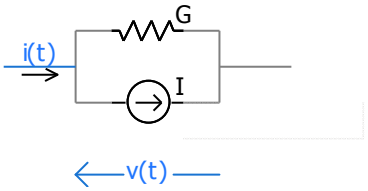


$$\frac{v(t) + v(t \quad dt)}{2} = L\frac{i(t) \quad i(t \quad dt)}{dt}$$

$$i(t) = \frac{dt}{2L}v(t) + i(t \quad dt) + \frac{dt}{2L}v(t \quad dt)$$

$$i(t) = G \quad v(t) + I(t)$$



Thank you.

Questions: support@pscad.com