Modeling Pantograph Dynamics

An ADAMS Macro Toolkit

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Project Purpose

Modeling toolbox for Pantograph systems in high speed trains
Historical Overview (I)

- **Nedtrain Consulting:** co-developer of ADAMS/Rail
- Currently using ADAMS/Rail + ADAMS/View for consultancies
- Nedtrain has 4 to 5 regular ADAMS users
- Need for simulations of pantograph /catenary dynamics
- Existing (competing) software is mainly FEM Based

Historical Overview (II)

- **SayField International:**
  - MSC.ADAMS competence center for Benelux,
  - Pre/post sales support, user support, consultancy, ADAMS courses (MSC & Uni’s)
  - ADAMS agency in Netherlands since 1996
  - Key ambition: *demonstrating to users how rapid they can be productive with ADAMS multi-body simulations*
  - Core activities: ADAMS customization & toolkits
Samples: Cable systems

Samples: Discrete Cable systems
Samples: Hexapod Platforms

Samples: Citroen Pluriel Roof
Recent Work with Prospects

- Task for Vortech Engineering + ECN: *Finding a suitable simulation tool for describing wind dynamics effects in wind turbines using User Code*
- MSC.Software offered flying start license: ADAMS Course + trial period to use software.
- For Vortech & ECN: evaluation of suitability of ADAMS code

After 2 days course & 4 days modeling
Pantographs: Project Challenge

- Creating a toolkit in MSC.ADAMS
- Must work in ADAMS/View (+ in A/Rail)
- Must enable easy modeling and extension of functionality
- Interaction through state-of-the-art GUI
- Modeling Contact wire dynamics: Catenary-Wire contact and flexibility of wires:
  - Apply discrete flexibility first,
  - later also ADAMS/Flex modal description of wires

Modeling Approach (i)

- Component Macros with support of:
  - Exchange of models and macros
  - Easy macro adaption for support of knowledge development and use of model level of detail
  - Model storage: known user entities (UDE concept)
  - ADAMS can be made to speak the user's language
- Graphical support in ADAMS GUI
  - Generic dialogs for each component macro
    - only 2 dialogs to maintain: 1) Macro 2) Data
Modeling Approach (ii)

- Component Data:
  - Parametrised model components
  - Fully prepared for design study/optimization
  - Stored in documented ASCII files
  - User only creates component Macros, GUI is generic and adjusts to user data.
  - Method applies ADAMS UDE’s: User Defined Entities
- Toolkit Basics:
  - UDE Types for component equations: i.e NPS_Pantograph
    - UDE Sub Types for multiple versions: (simple, two_mass, etc.)
    - Each Sub Type defined unique Data Structure (stored in UDE)
  - Toolkit Tools to manipulate models using dedicated dialogs

Example dialogs

- Tear-off menus
- UDE Data Dialog
- UDE Dialog
- Dedicated toolbar
Complete toolkit definition is stored as property lines in ASCII File

Simulation Results

Time domain, 10 secs, fixed camera front view
Time domain, 10 secs, fixed camera rear view

Time domain, 10 secs, moving camera rear view
Current Status

- Macros functioning and stable
- Pantograph models not yet completed
- F77 contact subroutine to be implemented
- First test runs with 10 span catenary (600 meters, 100 discrete parts) show fast runs (few minutes)
- Feedback from Nedtrain will be processed.
Toolbox Creator: Work to be done

- Further testing of GUI elements
- Model *rebuild* functionality:
  - Script like model storage (1 page full model)
  - Build file created from hand-build model
  - Parametrized model building: level of complexity
- Embedding of other toolboxes
- Testing with current & new customers

Thank You