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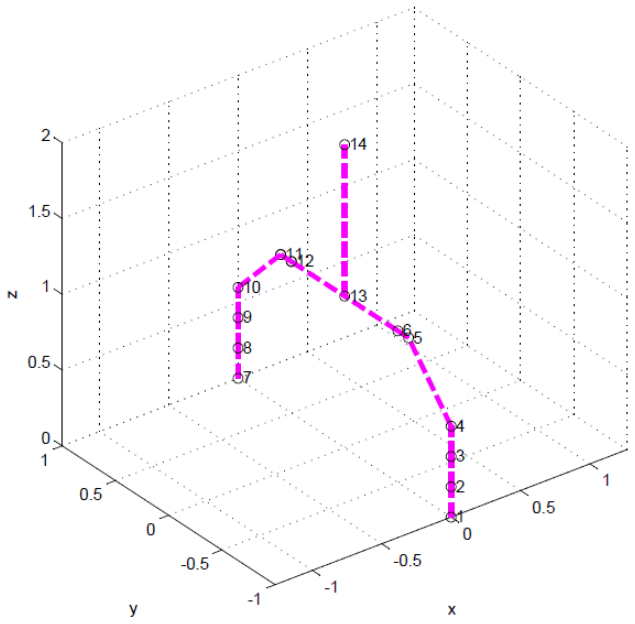
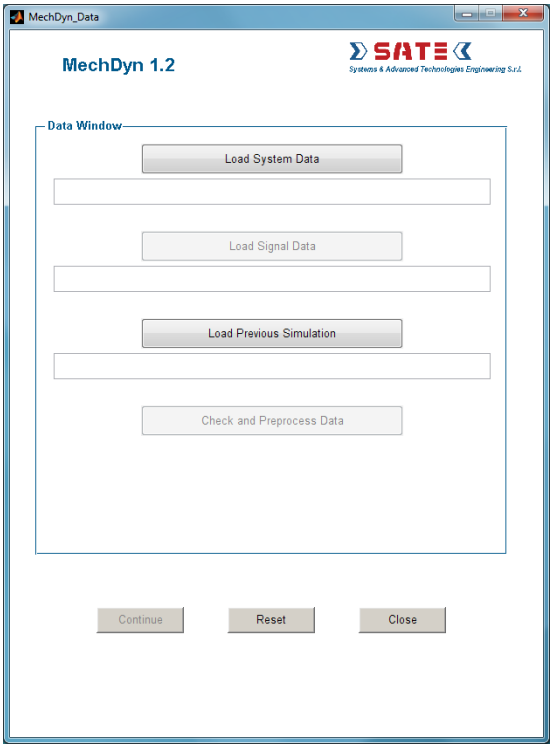
MECHDYN™

A STATIC AND DYNAMIC MECHANICAL SIMULATOR



MECHDYN™ structural model: example of rigid fork



MECHDYN™ main window, clean and simple

OVERVIEW

Complex mechanical structures made up of beam-like elements are widespread in the industry (e.g. metal carpentry, piping, long components in general) and — as all the other mechanical structures — are subjected to a wide range of dynamic phenomena (e.g. transients, vibrations, internal resonances, resonances with other systems they are in contact with). Very often these phenomena are critical to the main process (if the structure is an auxiliary plant) or to the business (if the structure is itself the main plant).

Because of this, the mechanical analysis of the structures (deformation under external loads, natural frequencies, vibrating modes) is a common practice in the industry, and a lot of software exists that carries it out.

Indeed much of the existing software performs the static analysis of the system (i.e. it provides the deformation under external loads) and the dynamic stationary analysis (i.e. it provides the natural frequencies, the vibrating modes, and the stationary response to a periodic input). Few software allows a complete dynamic analysis of the system, considering general arbitrary inputs in the time domain.

MECHDYN™ is a MATLAB® / SIMULINK® based simulation software which carries out a complete static and dynamic analysis of beam-like mechanical structures. In particular it allows the engineers to:

- perform the usual static analysis;
- calculate the natural frequencies, the vibrating modes, the transfer functions and the response to periodic inputs;
- calculate the transient response in the time domain to a variable arbitrary input;
- describe the mechanical structure as a state-space system, and nest it into more complex plant models in order to investigate the behaviour of the whole plant under critical situations.

MECHDYN™ is integrated with ***ACUSYS®***, S.A.T.E.'s suite for the analysis of the fluid pulsations in the piping systems (in frequency and time domain).

SATE
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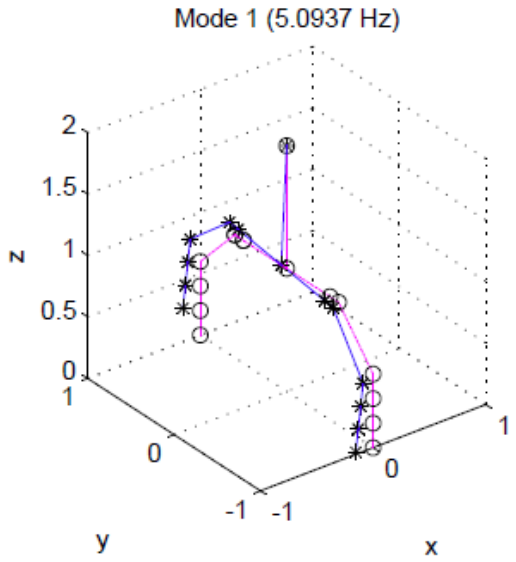
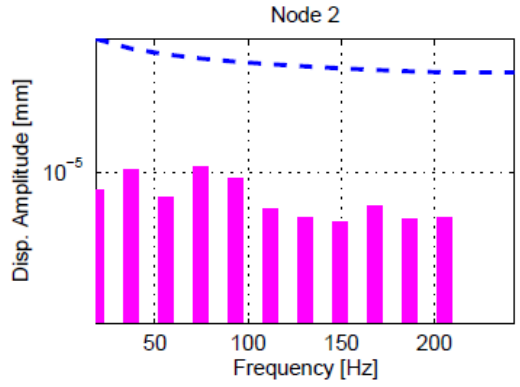


MECHDYN™ result plots: undeformed structure (magenta) and vibrating modes (blue)



MECHDYN™ result plots: comparison of vibration harmonics amplitude at a structure node with API 618 limits

PROGRAM DESCRIPTION

MECHDYN™ uses a finite element approach to describe the beam structure and solve the mechanical problem. In particular:

- it exploits the Bernoulli's or Timoshenko's beam theory to write the stiffness, mass, and damping matrices of the single beam elements;
- it assembles the element matrices into the global matrices of the structure (stiffness, mass, damping matrices);
- from the global matrices, it builds the state-space system describing the dynamic behaviour of the structure;
- it uses the state-space system to solve the mechanical problem;
- it performs the comparison between the response and the API 618 vibration limits for piping networks.

MECHDYN™ can also be easily embedded into a wider Simulink® model to get the dynamic behaviour of the extended system.

USER INTERFACE

MECHDYN™ runs into the MATLAB® / SIMULINK® environment, and it is friendly interfaced to the user by graphic buttons and menu commands.

RELIABILITY

MECHDYN™ has been extensively validated against comparison with theoretical solutions and other finite elements structural codes, in particular with benchmark cases of the NAFEMS (National Agency for Finite Element Methods and Standards, www.nafems.org).

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Asse 1 Azione 1.1.3: Contributi per l'utilizzo da parte delle imprese di strutture qualificate per l'attività di ricerca

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