SIGMA/SAMS Chain Wizard

Modeling Tool for Chain and Belt Systems

Rapid Innovation through Powerful Modeling Tools

CHAIN AND BELT DRIVE SYSTEMS ARE WIDELY UTILIZED THROUGHOUT AUTOMOTIVE, AREOSPACE, AND MANUFACTURING INDUSTRIES FOR MECHANICAL POWER TRANSMISSION AND MATERIAL TRANSPORT

SIGMA/SAMS has recently incorporated new accelerated model development features for modeling flexible-link chain and belt drive systems. The Chain Wizard allows for ease of use and swift model development by design engineers, with the accuracy of results required by analysts. The chain drive modeling tool can be employed to rapidly develop a chain or belt drive system that can be evaluated in SIGMA/SAMS software. Dynamic simulation of chain and belt drive systems can be performed by utilizing multibody system (MBS) algorithms. With the Chain Wizard, the user can choose to simulate either a rigid-link chain or **flexible-link chain systems.** In the case of flexible-link chain, the FE **Absolute Nodal Coordinate Formulation** (ANCF) is used.

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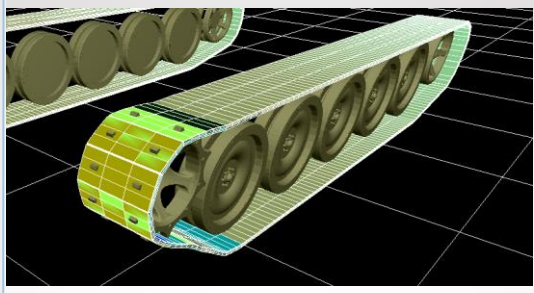
- **Tracked Vehicle Dynamics**
- **Modeling of Power Transmission Components**
- **Absolute Nodal Coordinate Formulation**
- **Stress Analysis of Chain Drive System**



Stress Analysis of Tracked Vehicle

Stress Analysis of Tracked Vehicle Chain Drive

The software SIGMA/SAMS, developed by CDI, allows for performing online stress analysis of flexible link chains and belt drives modeled using the FE absolute nodal coordinate formulation (ANCF).

After performing a simulation which has incorporated flexible components, the stress analysis post-processor can be employed to animate the simulation in which the stresses in the flexible body are shown as they are developed over the duration of the simulation. SIGMA/SAMS is capable of capturing the stresses that occur in the duration of the simulation.

Development of I-CAD-A

Newly developed efficient and general **multibody System** (MBS) codes will allow for the **integration of computer aided design and analysis** (I-CAD-A). New software that allows for the efficient design, development and analysis of mechanical systems can be utilized to develop complete high fidelity systems early in the design cycle.

Early insight in performance of mechanical system can reduce product design time allowing for **decreased time-to-market**. Accurately modeling the effect of dynamic loading on system components can reduce the need for physical prototyping and testing.

It can also be used to develop multiple variant designs to **optimize performance quickly**. Optimized designs can be assessed under various conditions to provide **confidence in system performance** before committing to manufacturing of components, which can **reduce manufacturing costs**.

Figure 1. Roller chain model

Modeling of Flexible Chain Systems

SIGMA/SAMS utilizes the FE **ANCF** in the dynamic simulation of chain drive systems. Unlike conventional FE programs where stresses and deformations are determined at a post-processing stage given predetermined boundary conditions, SIGMA/SAMS incorporates the flexible components directly into the dynamic simulation. This allows the system to react to the deformation within the dynamic simulation, capturing effects that will not be observed when conducting the flexible analysis at a post-processing stage or through software utilizing a co-simulation technique. Simulations performed using formulations that allow for large deformation and rotation such as ANCF to be encompassed in the dynamic simulation can provide greater insight to the performance of a system early in the design, before committing time and resources to non-optimized designs. SIGMA/SAMS possesses an exceptional ability to ensure the accuracy of results of properly modeled systems using flexible bodies. The ANCF was proposed by CDI affiliates and further developed by CDI researchers.

Development of Chain Drive: Features

Multiple chain and belt drives can be produced at one time to grant the ability of modeling of systems in which there are multiple chain or belt sets, such as timing chains or belts; or track chains for tracked vehicles.

After completion of design within the Chain Wizard, rigid body models as well as models containing chains composed of fully parameterized and gradient deficient ANCF elements can be created simultaneously to allow the user to evaluate different aspects of the system performance.

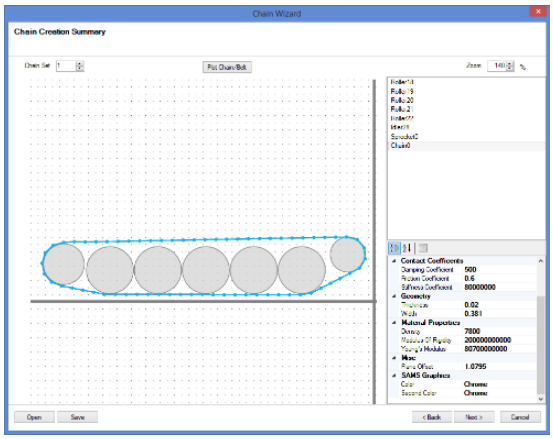


Figure 2. Chain Wizard plot screen showing track for tracked vehicle chain set

Development of Chain Drive: Procedure

SIGMA/SAMS Chain Wizard allows the user to create a chain drive model in a few easy steps. The user can model a chain system that consists of a combination of any of the following: sprockets, chain links or belts, rollers, and grounds (which can be used to simulate chain or belt guides). Key properties are provided by the user for each of the sprockets, rollers, chain links, and grounds. Based on the information provided, the chain system is determined for the given input. A visualization of the system generated is then shown in the Chain Wizard plot screen. If the user is satisfied with the created model, then the data can be exported to either the SIGMA/SAMS main processor or the SIGMA/SAMS pre-processor in the case of a model utilizing ANCF elements. The model created may be combined with other previously developed components or systems by using the SIGMA/SAMS *Subsystem Model* feature to quickly develop large and complex models consisting of smaller sub models.

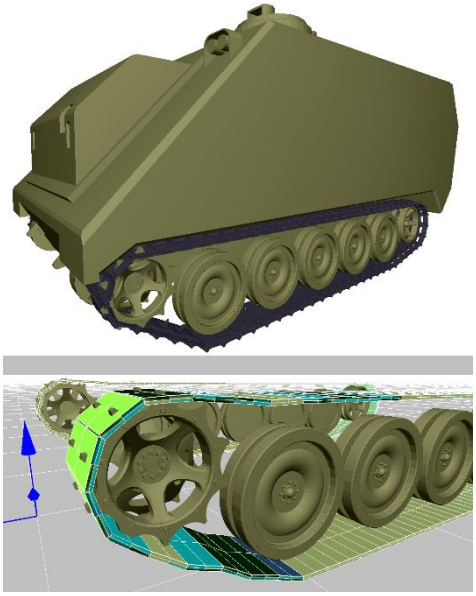


*Figure 3. Visualization of a tracked vehicle model and stress analysis using **SIGMA/SAMS** software*

Development of Belt Drive

Additionally, the Chain Wizard is capable of developing various FE ANCF belt drive models. A diverse array of belt system applications can be created through a similar sequence of events as the chain systems are created in the Chain Wizard. Power transmission belts as well as conveyors and material transportation belts can be simulated utilizing the belt system capabilities of the Chain Wizard. With the advantage of SIGMA/SAMS and the Chain Wizard capabilities, engineers can obtain a sharpened vision of the system level performance of designs in response to complex operating conditions with uncompromised accuracy.

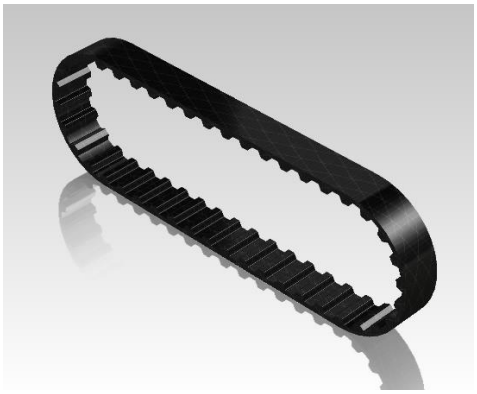


Figure 4. Toothed Belt Model

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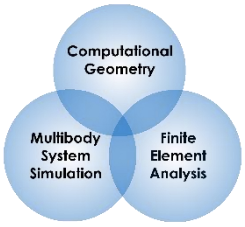
CDI Mission

SIGMA/SAMS is a general **multibody System** (MBS) code capable of solving both **small and large deformation** problems using integrated finite element and multibody system algorithms. SIGMA/SAMS developed by CDI can be used in the analysis of systems that consist of interconnected rigid and deformable bodies. The users of SIGMA/SAMS do not need to have other commercial finite element codes to perform flexible MBS simulations.



CDI develops the state of the art MBS software that can be used for building physics and engineering system models with significant details. CDI provides consulting services for industries and government laboratories. CDI engineers are well trained to perform simulations that can be used in the analysis, **performance evaluation and design of mechanical systems** that include machine, automotive, rail, aerospace and robotics systems. **Consulting services** that help the industry better interpret and make better use of the results of MBS computer programs can also be provided.

FIND OUT MORE

LEARN MORE ABOUT HOW CDI PRODUCTS AND SERVICES CAN HELP YOUR BUSINESS ACHIEVE MORE

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