Professional Multi-Body Dynamics Simulation Software

- MFBD
- Optimization
- Particles
- Automation / Customization
- Control
- Toolkits
Professional Multi-Body Dynamics Simulation Software

**Multi-Body Dynamics (MBD)**
- Convenient geometry-based rigid body modeling.
- Various kinematic joints and force elements.
- Powerful yet simple modeling of mathematical functions.
- Diverse, fast, and accurate contact models (Solid Contact, Geo Contact, Analytical Contact).

**CAD Interface**
- Uses the Parasolid kernel for high compatibility.
- Supports a variety of CAD file formats (CATPart, CATProduct, STEP, IGES, STL, ACIS, and others).

**Easy modeling** with **fast and accurate analysis** of rigid and flexible bodies using various toolkits

System analysis, component analysis, and durability analysis in a **single environment**
Multi Flexible Body Dynamics (MFBD)

- All rigid-body modeling elements (joints, forces, contacts) can be used with flexible bodies.
- Supports both advanced nonlinear finite elements (FFlex) or linearized modal reduction (RFlex) for modeling body flexibility.
- RecurDyn/Durability uses the time domain response of flexible bodies to calculate stress, fatigue life, and safety factor.
- FFlex: Nonlinear finite elements for large motion and large deformation with linear or nonlinear material models, including hyperelastic and elastic-plastic materials. Excellent for complex, nonlinear deformation and contact problems.
- RFlex: Motion represented using a highly-mobile rigid reference frame. Deformation represented through linearization based on modal reduction. Provides extremely fast calculation. Excellent for bodies with arbitrarily large motion but small deformation.

Control

- Co-simulation with a wide range of control system design software (Simulink and AMESIM).
- Supports general co-simulation through FMI (Modelica).
- Includes CoLink, a proprietary control system modeling tool, deeply integrated into RecurDyn to provide extremely fast and accurate control systems analysis.

Post Processor

- Integrated post processor.
- Animation of results.
- Plotting for such output as position, velocity, acceleration, reaction forces, stress, strain.
- Contour plot animation of flexible body results for stress strain and contact pressure.
- Easy-to-use data exporting for working with data in external software, such as Microsoft Excel.
- Generation of AVI movie files of animations and contour plots.
- Various functions and operations, such as interpolation, calculus, FFT, and filters, can be applied to the analysis results.
RecurDyn combines dynamic analysis of the dynamics of rigid bodies and nonlinear flexible bodies experiencing large deformations and contact with control system analysis, optimization, and particle-based fluid and granular material analysis using the MPS and DEM methods.

- **Multi-disciplinary**
  - Flexible
  - FFlex
  - RFlex
  - Durability
  - Linear
  - RFlexGen
  - Optimization
  - AutoDesign

- **Toolkits**
  - Automate complicated modeling and analysis for specific tasks, enabling both experts and designers to easily analyze complex problems
  - Machinery
    - Gear
    - Bearing
    - Chain
    - Belt
    - Spring
  - Engine
    - Crank
    - Piston
    - Valve
  - Track
    - TrackLM
    - TrackHM
  - Media Transport
    - MTT2D
    - MTT3D

- **Automation & Customization**
  - Powerful automation and customization tools for RecurDyn to improve modeling and analysis efficiency for customer-specific needs
  - ProcessNet
  - eTemplate

- **Communicators**
  - CAD Translators
    - STEP
    - IGES
    - ACIS
  - CAE Interfaces
    - CATIA
    - Simulink
    - AMESim
    - FMI
    - Particleworks

- **Industries**
  - Automotive
  - Defense
  - Construction Equipment
  - OA, Printing
  - Aerospace
  - Plant Automation
  - Electrical, Electronics
  - Elevator
RecurDyn includes various libraries of bodies, joints, and forces for rigid body modeling as well as various contact libraries that enable you to easily model mechanical systems. The rigid body solver, which is based on a recursive formula, can perform dynamic and static analyses as well as various other kinds of analyses quickly, accurately, and stably. RecurDyn also includes various functionality to aid in the analysis of the results such as 3D animations and plots.

- **Intuitive UI**
  - The UI allows designers to perform modeling quickly and conveniently.

- **High-Performance Graphics Engine**
  - The MBD-optimized graphics engine easily manipulates complex models.

- **Fast and Convenient Post-Processor**
  - The animation and plot outputs allow you to easily and intuitively examine the results of a dynamic analysis, such as the magnitude and direction of the displacements, velocities, accelerations, and forces.

- **Fast and Accurate Solver**
  - The recursive formulation and the implicit G-Alpha integrator calculate analyses quickly, accurately, and stably.
  - The contact algorithms of RecurDyn are exceptionally robust, enabling the analysis of problems with very complex contact.
**MFBD**

MFBD (Multi Flexible Body Dynamics) is the analysis of the dynamics of mechanical systems containing rigid and flexible bodies.

RecurDyn can perform fast and accurate analyses of mechanical systems that contain both rigid and flexible bodies. The flexible bodies can be modeled using either modal decomposition (RFlex) for small, linear deformation problems or using advanced, nonlinear FE (FFlex) for large or complex deformation, complex contact, or nonlinear materials (hyperelasticity and plasticity). The same joint, force, and contact libraries for rigid bodies are available for use with flexible bodies as well. Internal stresses, strains, and displacements can be analyzed, as well as the durability of the bodies.

**RFlex**

An advanced, nonlinear FE method for flexible bodies that undergo large motion with large or complex deformation, complex contact, and nonlinear materials.

**FFlex**

An advanced, nonlinear FE method for flexible bodies that undergo large motion with large or complex deformation, complex contact, and nonlinear materials.

**RFlexGen**

RecurDyn can produce an RFlex body from an FFlex body using the included Dynamis solver to perform a modal analysis of the body. External FEA software is not needed to perform the modal analysis.

**Mesher**

RecurDyn's powerful embedded mesher can generate a finite element mesh from rigid body geometry to create an FFlex body without the need for external meshing software. In addition, external mesh data also can be used (e.g., Nastran BDF data).

**Durability**

The integrated fatigue/durability analysis solver can calculate fatigue life, fatigue damage, and safety factor. The results can be output in the FEMFAT format.
RecurDyn offers the ability to analyze MFBD systems that interact with either granular solids or fluids. Granular solids, such as soil, sand, or printer toner, are modeled using RecurDyn/Particles, which is based on a discrete element method (DEM). Fluid dynamics is available through co-simulation with the MPS-based CFD software Particleworks. RecurDyn has a special interface for Particleworks that makes co-simulation between them simple.

**RecurDyn/Particles**

- RecurDyn includes the SAMADII/DEM solver from Metariver Technology to analyze granular solid material. SAMADII/DEM is based on the Discrete Element Method (DEM).
- Pre-processing, including the creation of particles and setting contact parameters as well as post-processing to analyze the results of the particle behavior can all be achieved from within the RecurDyn environment.

**RecurDyn/Particleworks IF**

- RecurDyn/Particleworks IF is a special interface in RecurDyn designed for co-simulation of MFBD in RecurDyn with fluid dynamics in Particleworks from Promotech. Particleworks is a computational fluid dynamics (CFD) software based on the Moving Particle Simulation (MPS) method.
- Through co-simulation with Particleworks, the analysis of the coupled interaction between a mechanical system and a fluid can be analyzed.
- The streamlined co-simulation interface provides coupled MFBD-fluid simulation in a simple analysis environment.

**RecurDyn - Particleworks**

- Position, velocity, and acceleration of the engine
- Hydrodynamic forces applied to the engine, crankshaft, and pistons

**Analysis of the impact of fluid to the underside of a vehicle as it drives through a puddle**

*Courtesy of Thomas Freuler and FunctionBay K.K.*

*Courtesy of Alex Worsfold and FunctionBay K.K.*
Accurate and robust models of a mechanism are required for the design and parameter optimization of control system algorithms, as well as their reliability verification. RecurDyn provides a diverse set of tools to analyze mechanism models coupled with the control system algorithm.

RecurDyn provides an interface for co-simulation with the MATLAB/Simulink and AMESim software widely used in mechatronics to expand RecurDyn’s support for multidisciplinary analysis areas, such as control. In addition, RecurDyn supports FMI to incorporate the use of Modelica-based applications in analyses.

RecurDyn/CoLink allows for fast and accurate control system analysis through the deep integration of the control simulation code with RecurDyn’s dynamics solver.

• **RecurDyn/Control**
  - Matlab/Simulink
    RecurDyn/Control includes an interface for co-simulation with MATLAB/Simulink and Simplorer. This allows mechanical systems that contain control and drive systems, such as controllers and motors, to be analyzed.
  - AMESim
    RecurDyn/Hydraulic includes an interface for co-simulation with AMESim, hydraulic analysis software. This allows mechanical systems that contain a wide range of hydraulic systems to be analyzed.
  - FMI (Function Mockup Interface)
    RecurDyn supports FMI, a standard interface based on Modelica, and co-simulation with all applications that support FMI.

• **CoLink**
  - CoLink (developed by FunctionBay) is analysis software for control systems that uses block diagrams.
  - CoLink produces accurate analysis results more quickly than co-simulation because it is deeply integrated into RecurDyn’s dynamics solver.
Designing a mechanical system often involves optimizing the design variables with respect to specific performance metrics. Furthermore, creation of customized UIs and automation of repetitive tasks is often needed. For this purpose, RecurDyn provides a high performance optimization tool that requires very little knowledge of optimization to use, which includes a specialized UI and solver. RecurDyn also provides a specialized environment for the customization and the automation of repeated tasks.

**RecurDyn/AutoDesign**

- RecurDyn/AutoDesign is a built-in design optimization package that includes a world-class, advanced optimization solver that produces results quickly and accurately. RecurDyn/AutoDesign allows for defining design variables and design conditions to optimize objective functions, thereby producing optimal mechanical system designs.

**RecurDyn/ProcessNet**

- RecurDyn/ProcessNet is a powerful, comprehensive customization tool for the RecurDyn GUI. It enables users to create completely custom, powerful user interfaces within RecurDyn for their specific needs.
- Users make customizations by writing code in the C# programming language that accesses APIs in RecurDyn that allow the code to control the GUI. RecurDyn/ProcessNet includes in a built-in programming environment for this code development.
  - RecurDyn Library + C# Language

  ![Levels of customization](image)

<table>
<thead>
<tr>
<th>Level 1</th>
<th>Level 2</th>
<th>Level 3</th>
<th>Level 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Perform a batch run (simple automation)</td>
<td>Produce a user-created interface</td>
<td>Interconnect a utility or tool with RecurDyn</td>
<td>Create a new toolkit Produce a new application</td>
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</tbody>
</table>

**RecurDyn/eTemplate**

- RecurDyn/eTemplate is a tool that enables RecurDyn model data to be stored in Microsoft Excel spreadsheets. RecurDyn/eTemplate can read the data in a spreadsheet and create a model in RecurDyn from the data. RecurDyn/eTemplate is extremely powerful, yet simple, intuitive, and easy to use. It can be used as a powerful customization tool to make managing model data much more efficient and to enable less experienced RecurDyn users to perform more complex and meaningful simulations.
- Through eTemplate, users with little experience with RecurDyn can create and modify models and perform powerful analysis.
Toolkits

**Machinery**

The machinery toolkits contain customized UIs to facilitate the modeling of the elements of mechanical systems common to machinery, such as gears, chains, belts, bearings, and springs. These toolkits have specialized solvers optimized for these elements. This allows the user to perform modeling quickly and easily and conduct an accurate analysis of complicated mechanical systems.

- **RecurDyn/Gear**
  - The RecurDyn/Gear toolkit is used to define and analyze systems of gears. It defines the gear geometry, the contact surfaces, and it provides a specialized solver code for the gear system.

- **RecurDyn/Chain**
  - The RecurDyn/Chain toolkit dramatically simplifies the modeling of complex chain systems and automatically defines contacts within the chain system, including contacts between the chain links. It also includes a highly specialized solver for chain systems.

- **RecurDyn/Belt**
  - The RecurDyn/Belt toolkit is used for the modeling of belts and pulleys systems. MFBD technology can be used, which makes it possible to produce more realistic analyses by modeling belts as flexible bodies.

- **RecurDyn/Bearing**
  - The RecurDyn/Bearing toolkit is used for the modeling of bearing systems. It simplifies the creation of bearings and the contact surfaces. The toolkit also supports EHD (fluid) bearings and simulates lubrication properties during analysis (RecurDyn/EHD is required).

- **RecurDyn/Spring**
  - The RecurDyn/Spring toolkit allows you to model double springs or nonlinear springs using multi-mass springs and perform realistic spring modeling that considers self-contact.

**Engine**

Recur Dyn’s engine toolkits dramatically simplifies the modeling and analysis of the major components of internal combustion engine systems, such as valves, pistons and crankshafts. This allows you to create and analyze highly realistic engine models quickly and easily.

- **RecurDyn/Valve**
  - The RecurDyn/Valve toolkit is for the design and analysis of valve train systems. It automates the creation of valve train assemblies. This toolkit supports various valve types and camshafts. It also allows for the use of flexible bodies in the analysis.

- **RecurDyn/Piston**
  - The RecurDyn/Piston toolkit automates the creation of engine piston systems. The toolkit is designed for contact analyses of pistons and cylinders. It can perform a bearing analysis that models the lubrication properties of EHD bearings between a piston pin and connecting rod or between a piston pin and piston (RecurDyn/EHD is required).

- **RecurDyn/Crank**
  - The RecurDyn/Crank toolkit automates the creation of drive shaft-related parts, such as crankshafts, balancing shafts, and flywheels.
**Tracked Vehicles**

The Track toolkits allow efficient modeling and analysis of the tracked vehicle systems frequently used in construction equipment and military vehicles such as tanks. These toolkits significantly reduce the time needed for modeling and allow for fast and accurate analysis through a specialized solver.

**RecurDyn/TrackLM**
- The RecurDyn/TrackLM toolkit includes various libraries (for example, Track Link, Wheel, and Sprocket) for the simplification of the modeling of the low-speed tracked vehicle systems used in construction and heavy equipment.
- The toolkit includes a UI and analysis solver optimized for low-speed tracked vehicle systems.

**RecurDyn/TrackHM**
- The RecurDyn/TrackHM toolkit includes various libraries (for example, Track Link, Wheel, and Sprocket) for the simplification of the modeling of the high-speed tracked vehicle systems used in tanks and military vehicles.
- The toolkit provides a UI and analysis solver optimized for high-mobility tracked vehicle systems.

**Media Transport**

RecurDyn’s media transport toolkits are for analyzing transport systems for flexible media, such as paper, films, and cards. This toolkit automates the modeling and analysis of sheets as flexible bodies and dramatically simplifies the creation of rollers and guides, making it the ultimate tool for the layout and design of media transport systems. In addition, the toolkits also include various sensors and tools to model air resistance, suction, and static electricity.

**RecurDyn/MTT2D**
-RecurDyn/MTT2D is used to model media transport systems in 2 dimensions. It provides very rapid analyses, making it optimal for designing the general layout of transport systems. Rollers can be modeled as flexible bodies made of such materials as rubber or sponge to capture the effect of roller flexibility on the behavior of the media.

**RecurDyn/MTT3D**
- The RecurDyn/MTT3D toolkit is designed to analyze fully 3-dimensional media transport systems.
- The media is modeled as flexible bodies using MFBD technology.
- This toolkit includes an optimized solver that performs analyses quickly, robustly, and accurately.
### System Requirements

<table>
<thead>
<tr>
<th>OS</th>
<th>Windows 7, Windows 8</th>
</tr>
</thead>
<tbody>
<tr>
<td>CPU</td>
<td>2.4GHz (Recommended: 3.4 GHz, Quad Core or Better)</td>
</tr>
<tr>
<td>RAM</td>
<td>2GB (Recommended: 4GB or more)</td>
</tr>
<tr>
<td>HDD</td>
<td>3GB (Recommended: 10GB or more)</td>
</tr>
<tr>
<td>VGA</td>
<td>1280x1024 resolution or greater (Recommended: Display adapter that supports an OpenGL ICD)</td>
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<tr>
<td>ODD</td>
<td>DVD-R or above</td>
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