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Initial information MATLAB is given in this volume to allow to present next the Simulink package and the Flight Dynamics Toolbox, providing for rapid simulation-based design. MATLAB is the foundation for all the MathWorks products. Here we would like to discus products of MathWorks related to the simulation, especially Code Generation tools and Dynamic System Simulation.

Code Generation and Rapid Prototyping

The MathWorks code generation tools make it easy to explore real-world system behavior from the prototyping stage to implementation. *Real-Time Workshop* and *Stateflow Coder* generate highly efficient code directly from Simulink models and Stateflow diagrams. The generated code can be used to test and validate designs in a real-time environment, and make the necessary design changes before committing designs to production. Using simple point-and-click interactions, the user can generate code that can be implemented quickly without lengthy hand-coding and debugging. Real-Time Workshop and Stateflow Coder automate compiling, linking, and downloading executables onto the target processor providing fast and easy access to real-time targets. By automating the process of creating real-time executables, these tools give an efficient and reliable way to test, evaluate, and iterate your designs in a real-time environment.

Real-Time Workshop, the code generator for Simulink, generates efficient, optimized C and Ada code directly from Simulink models. Supporting discrete-time, multirate, and hybrid systems, Real-Time Workshop makes it easy to evaluate system models on a wide range of computer platforms and real-time environments.

Stateflow Coder, the standalone code generator for Stateflow, automatically generates C code from Stateflow diagrams. Code generated by Stateflow Coder can be used independently or combined with code from Real-Time Workshop.

Real-Time Windows Target, allows to use a PC as a standalone, self-hosted target for running Simulink models interactively in real time. Real-Time Windows Target supports direct I/O, providing real-time interaction with your model, making it an

easy-to-use, low-cost target environment for rapid prototyping and hardware-in-the-loop simulation.

xPC Target allows to add I/O blocks to Simulink block diagrams, generate code with Real-Time Workshop, and download the code to a second PC that runs the xPC target real-time kernel. xPC Target is ideal for rapid prototyping and hardware-in-the-loop testing of control and DSP systems. It enables the user to execute models in real time on standard PC hardware.

By combining the MathWorks code generation tools with hardware and software from leading real-time systems vendors, the user can quickly and easily perform rapid prototyping, hardware-in-the-loop (HIL) simulation, and real-time simulation and analysis of your designs. Real-Time Workshop code can be configured for a variety of real-time operating systems, off-the-shelf boards, and proprietary hardware.

The MathWorks products for control design enable the user to make changes to a block diagram, generate code, and evaluate results on target hardware within minutes. For turnkey rapid prototyping solutions you can take advantage of solutions available from partnerships between The MathWorks and leading control design tools:

- *dSPACE Control Development System*: A total development environment for rapid control prototyping and hardware-in-the-loop simulation;
- *WinCon*: Allows you to run Real-Time Workshop code independently on a PC;
- *World Up*: Creating and controlling 3-D interactive worlds for real-time visualization;
- *ADI Real-Time Station*: Complete system solution for hardware-in-the loop simulation and prototyping.
- *Pi AutoSim*: Real-time simulator for testing automotive electronic control units (ECUs).
- *Opal-RT*: a rapid prototyping solution that supports real-time parallel/distributed execution of code generated by Real-Time Workshop running under the QNX operating system on Intel based target hardware.

Dynamic System Simulation

Simulink is a powerful graphical simulation tool for modeling nonlinear dynamic systems and developing control strategies. With support for linear, nonlinear, continuous-time, discrete-time, multirate, conditionally executed, and hybrid systems, Simulink lets you model and simulate virtually any type of real-world dynamic system. Using the powerful simulation capabilities in Simulink, the user can create models, evaluate designs, and correct design flaws before building prototypes.

Simulink provides a graphical simulation environment for modeling dynamic systems. It allows to build quickly block diagram models of dynamic systems. The Simulink block library contains over 100 blocks that allow to graphically represent a wide variety of system dynamics. The block library includes input signals, dynamic elements, algebraic and nonlinear functions, data display blocks, and more. Simulink blocks can be triggered, enabled, or disabled, allowing to include conditionally executed subsystems within your models.

FLIGHT DYNAMICS TOOLBOX – FDC 1.2

report by Marc Rauw

FDC is an abbreviation of Flight Dynamics and Control. The FDC toolbox for Matlab and Simulink makes it possible to analyze aircraft dynamics and flight control systems within one software environment on one PC or workstation. The toolbox has been set up around a general non-linear aircraft model which has been constructed in a modular way in order to provide maximal flexibility to the user. The model can be accessed by means of the graphical user-interface of Simulink. Other elements from the toolbox are analytical Matlab routines for extracting steady-state flight-conditions and determining linearized models around user-specified operating points, Simulink models of external atmospheric disturbances that affect the motions of the aircraft, radio-navigation models, models of the autopilot, and several help-utilities which simplify the handling of the systems. The package can be applied to a broad range of stability and control related problems by applying Matlab tools from other toolboxes to the systems from FDC 1.2. The FDC toolbox is particularly useful for the design and analysis of Automatic Flight Control Systems (AFCS). By giving the designer access to all models and tools required for AFCS design and analysis within one graphical Computer Assisted Control System Design (CACSD) environment the AFCS development cycle can be reduced considerably. The current version 1.2 of the FDC toolbox is an advanced proof of concept package which effectively demonstrates the general ideas behind the application of CACSD tools with a graphical user- interface to the AFCS design process.