James Collier, Loring Craymer, and David Curkendall of Caltech for NASA’s Jet Propulsion Laboratory. Further information is contained in a TSP (see page 1).

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ANTLR Tree Grammar Generator and Extensions

A computer program implements two extensions of ANTLR (Another Tool for Language Recognition), which is a set of software tools for translating source codes between different computing languages. ANTLR supports predicated-LL(1) lexer and parser grammars, a notation for annotating parser grammars to direct tree construction, and predicated tree grammars. "LL(1)" signifies "left-right, leftmost derivation with 1 token of look-ahead," referring to certain characteristics of a grammar.) One of the extensions is a syntax for tree transformations. The other extension is the implementation-specific subfunctions, the application-specific Kalman-filter software can be compiled and executed immediately. During execution, the generic Kalman-filter function uses the aforementioned data structures and five implementation-specific subfunctions, which have been developed by the user on the basis of the aforementioned templates. The GKF software can be used to develop many different types of unfactorized Kalman filters. A developer can choose to implement either a linearized or an extended Kalman filter algorithm, without having to modify the GKF software. Control dynamics can be taken into account or neglected in the filter-dynamics model. Filter programs developed by use of the GKF software can be made to propagate equations of motion for linear or nonlinear dynamical systems that are deterministic or stochastic. In addition, filter programs can be made to operate in user-selectable “covariance analysis” and “propagation-only” modes that are useful in design and development stages.

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Generic Kalman Filter Software

The Generic Kalman Filter (GKF) software provides a standard basis for the development of application-specific Kalman-filter programs. Historically, Kalman filters have been implemented by customized programs that must be written, coded, and debugged anew for each unique application, then tested and tuned with simulated or actual measurement data. Total development times for typical Kalman-filter application programs have ranged from months to weeks. The GKF software can simplify the development process and reduce the development time by eliminating the need to re-create the fundamental implementation of the Kalman filter for each new application. The GKF software is written in the ANSI C programming language. It contains a generic Kalman-filter-development directory that, in turn, contains a code for a generic Kalman filter function; more specifically, it contains a generically designed and generically coded implementation of linear, linearized, and extended Kalman filtering algorithms, including algorithms for state- and covariance-update and -propagation functions. The mathematical theory that underlies the algorithms is well known and has been reported extensively in the open technical literature. Also contained in the directory are a header file that defines generic Kalman-filter data structures and prototype functions and template versions of application-specific subfunctions and calling “navigation/estimation” routine code and headers. Once the user has provided a calling routine and the required application-specific subfunctions, the application-specific Kalman-filter software can be compiled and executed immediately. During execution, the generic Kalman-filter function is called from a higher-level “navigation” or “estimation” routine that preprocesses measurement data and postprocesses output data. The generic Kalman-filter function uses the aforementioned data structures and five implementation-specific subfunctions, which have been developed by the user on the basis of the aforementioned templates. The GKF software can be used to develop many different types of unfactorized Kalman filters. A developer can choose to implement either a linearized or an extended Kalman filter algorithm, without having to modify the GKF software. Control dynamics can be taken into account or neglected in the filter-dynamics model. Filter programs developed by use of the GKF software can be made to propagate equations of motion for linear or nonlinear dynamical systems that are deterministic or stochastic. In addition, filter programs can be made to operate in user-selectable “covariance analysis” and “propagation-only” modes that are useful in design and development stages.

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