CONVERTING BLOCK DIAGRAMS INTO THE OVERALL TRANSFER FUNCTION

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Control systems are usually represented by block diagrams (Fig. 1) or signal flow graphs. Both these representations often have to be simplified and converted into form of the overall transfer function (Fig. 2). Block diagrams can be simplified using block diagram algebra (manipulation). It is set of rules which are applied in converting process by a heuristic procedure. The procedure consists of several alternating steps: simplification (removing blocks in series, parallel paths and feedback loops), moving objects (summing points, take-off points) ahead of or beyond the blocks, combining or expanding summing points and interchange of summing or take-off points.

Another used way of block diagram converting is its transformation into a signal flow diagram and resolution by means of Mason rule. The Mason rule requires finding all needed special subgraphs – loops and forward paths. For using of Mason rule (e.g. mason function by Rob Walton, TRLabs and the University of Calgary, Alberta, Canada) signal flow graphs have to given by list of signal flow graph branches or other their representation (adjacency matrix).

The above methods are compared with application of Matlab Symbolic Math Toolbox functions. This way seems to be suitable and applicable for every inexperienced Matlab user. The method is based on a simple application of the solve function. It is possible to work with transfer function given in general form or in the form of rational fractional function with numerical or symbolic coefficients.

Figure 1: Original block diagram

Figure 2: Block diagram converted into overall transfer function