Simulink Fault Patterns List

(a) The most common/recurring Simulink fault patterns identified based on our discussions with Delphi Engineers:

Fault Pattern	Corresponding Mutation Operator
Incorrect signal data types in math operations	Replacing a signal data type with a different data type, e.g., the MTALB '*double*' data type with MATLAB '*single*' data type, or MATLAB '*fixdt(0,8,3)*'data type with MATLAB '*fixdt(0,8,2)*' data type
Missing '*GoTo*' block of a '*From*' block	Removing the '*GoTo*' block corresponding to a '*From*' block
Missing '*Saturate on integer overflow*' in math operations blocks	Unchecking the '*Saturate on integer overflow*' property for the blocks with this property checked
Missing '*Signal name must resolve to Simulink signal object*' in properties of a signal	Unchecking the '*Signal name must resolve to Simulink signal object*' property for the signals with this property checked
Improper '*Merge*' block utilization	Adding a Merge block for two signals that should not be merged

(b) The Simulink fault patterns identified by reviewing the literature on mutation operators for Simulink models. Note that some of the mutation operators are similar to the fault patterns identified by Delphi engineers.

Mutation	Examples
Incorrect signal data types	Replacing the MTALB '*double*' data type with MATLAB '*single*' data type, or MATLAB '*fixdt(0,8,3)*'data type with MATLAB '*fixdt(0,8,2)*' data type
Incorrect Constant Value	Replacing constant '1' with constant '0', constant '0' with constant '1', and constant 'v' with constant 'v-1' and constant 'v+1'
Incorrect Simulink block	Incorrect Math Operator, e.g., replacing '+' with '-', and '-' with '+'
	Incorrect Relational Operator, e.g., replacing '<=' with '>=', and '==' with '~='
	Incorrect Logical Operator, e.g., replacing 'AND' with 'OR', and 'OR' with 'AND'
Incorrect connections	Switching the input lines of the 'Switch' block
Incorrect Stateflow Transition Conditions	Replacing '<' with '>' in a transition condition
Incorrect Stateflow State Actions	Replacing '+' with '-' or 'min' with 'max' in a state action
Wrong Initial Condition	Changing the initial value in '*Integration*' and '*Unit Delay*' blocks