Glossary

**Anti-lock braking system (ABS)** is a system on automotive vehicles which prevents the wheels from locking while braking; the purpose of this is to allow the driver to maintain steering control under heavy braking and, in some situations, to shorten braking distances (by allowing the driver to hit the brake fully without the fear of skidding or loss of control); disadvantages of the system include increased braking distances under certain circumstances and the creation of a *false sense of security* among drivers who do not understand the operation and limitations of ABS.

**AC-DC commutator** -- The commutator is a mechanical AC-DC rectifier; for a rotary DC-AC commutator generator, the commutator mechanically switches the armature windings so that the resultant induced source AC armature voltages always act with the same sense of voltage polarisation; this requires a reversal of the armature winding connection every $\pi$ rad; the induced source AC armature voltages are mechanically rectified to the induced source DC armature voltage via commutator segments that contact the carbon brushes.

**AC-DC macrocommutator** -- The macrocommutator is an ASIM AC-DC rectifier; for a rotary DC-AC commutator generator, the macrocommutator electronically switches the armature windings so that the resultant induced source AC armature voltages always act with the same sense of voltage polarisation; this requires a reversal of the armature winding connection every $\pi$ rad; the induced source AC armature voltages are electronically rectified to induced source DC armature voltage via inputs of the ASIM that contact the output of the ASIM via bipolar electrical valves.

**Actuator** -- The component of an open-loop or closed-loop mechatronic control system that connects the electronic control unit (ECU) with the process; the actuator consists of a commutator and a final-control element; positioning electrical signals are converted to mechanical output.

**Algorithm** - A set of software instructions causing a computer to go through a prescribed routine; because embedded computer ECE or ICE controls have become so common, algorithms have become essentially synonymous with control law for automotive scientists and engineers.

**Analog input** -- Sensors usually generate electrical signals that are directly proportional to the mechanism being sensed; the signal is, therefore, analog signal or may vary from a minimum to a maximum limit.
Analog signal -- A signal in which the information of interest is communicated in the form of a continuous signal; the magnitude of this signal is proportional (or analogous) to the actual quantity of interest.

Analog-to-digital (A/D) converter -- An electronic device that produces a digital result that is proportional to the analog input voltage.

Architecture -- The organisational structure of an automotive-vehicle multiplex network, mainly referring to the application structure and communication protocol.

ASIC -- Application-specific integrated circuit, an IC designed for a custom requirement, frequently a gate array, single-chip microprocessor or programmable logic device.

ASIM -- Application-specific integrated matrixer, an IM designed for a custom requirement, frequently a gate array or single-chip macrocommutator.

Bus -- Topology of a communications network where all nodes are reached by links that allow transmission in both senses of direction.

Capacity -- Energy storage capability of the CH-E/E-CH storage battery, ultracapacitor, ultra-inductor or ultraflywheel.

Central processing unit (CPU) -- The portion of a computer system or microcontroller that controls the interpretation and execution of instructions and includes arithmetic capability.

CH-E/E-CH storage battery -- Self-contained CH-E/E-CH cell/cells or system that converts chemical energy to electrical energy in a reversible process.

Class A system -- A multiplex system whereby automotive-vehicle wiring is reduced by the transmission and reception of multiple signals over the same signal bus between nodes replacing the conventional wiring in automotive vehicles; the nodes used to accomplish multiplexed vehicle-body wiring typically did not exist in the same or similar form in totally conventionally wired vehicles.

Class B system -- A multiplex system whereby data, for example, parametric data values) is transferred between nodes to eliminate redundant sensors and other system elements; the nodes in this form of a multiplex system typically already existed as stand-alone modules in conventionally wired vehicles.
Class C system -- A multiplex system whereby high data rate signals typically associated with real-time mechatronic control systems, such as ECE or ICE controls and ABS, are sent over a signal bus to facilitate distributed control and to further reduce vehicle wiring.

Closed-loop mechatronic control -- A process by which a variable is continuously measured, compared with a reference variable, and changes as a result of this comparison in such a manner that the deviation from the reference variable is reduced; the purpose of closed-loop mechatronic control is to bring the value of the output variable as close as possible to the value specified by the reference variable in spite of disturbances; in contrast to open-loop mechatronic control, a closed-loop mechatronic control system acts to offset the effect of all disturbances.

Command mode -- A mode of operation of a master-slave system in which the master node takes prompt control of the network to achieve the input and/or output function.

Control mode -- Control mode and command mode are used interchangeably and refer to a mode of operation of a master-slave system in which the master node takes prompt control of the network to perform the input and/or output function.

Data collision -- A state of the bus in which two or more transmitters are turned on simultaneously to conflicting states.

Data consistency -- A feature of communications in some multiplex wiring systems whereby it is determined and ensured that all required recipients of a message have received the message accurately before acting upon it simultaneously; this feature is desirable in, for example, ensuring that all four vehicle brakes are energised simultaneously or four vehicle lamps are turned on at once.

D controller - A controller with the derivative characteristics.

DC-AC commutator -- The commutator is a mechanical DC-AC inverter; for a rotary DC-AC commutator motors or actuators, the commutator mechanically switches the armature windings so that the resultant force always acts with the same sense of rotary direction; this requires a reversal of the armature winding connection every \(\pi\) rad; the DC supply to the armature is via carbon brushes that contact the commutator segments.
**DC-AC macrocommutator** - The macrocommutator is an ASIM DC-AC inverter; for a rotary DC-AC commutator motors or actuators, the macrocommutator electronically switches the armature windings so that the resultant force always acts the same sense of rotary direction; this requires a reversal of the armature winding connection every $\pi$ rad; the DC supply to the armature is via an input of the ASIM that contacts via the bipolar electrical valves’ output of the ASIM.

**Defuzzification** -- The process of translating output grades to analogue output values.

**Depth of discharge (DoD)** -- Percentage of capacity [Ah] that has been removed from the CH-E/E-CH storage battery, ultracapacitor, ultrainductor, or ultraflywheel.

**Digital signal** -- A signal in which the information of interest is communicated in the form of a number; the magnitude of this number is proportional to (within the limitations of the resolution of the number) the actual quantity of interest.

**Digital signal processor (DSP)** -- A monolithic integrated circuit (IC) optimised for digital signal-processing applications; portions of device are similar to a conventional microprocessor; the architecture is highly optimised for the rapid, repeated additions and multiplications required for digital signal processing; digital signal processors may be implemented as programmable devices or may be realised as dedicated high-speed logic.

**Driver** -- A solid state device used to transfer electrical energy to the next stage that may be another driver, an electrical load (power driver), a wire or cable (line driver), a display (display driver), etc.

**Fault tolerance** -- Ability of a system to survive a certain number of failures while performing its required functions, but possibly with some degraded characteristics.

**Final-control element** -- The second or last stage of an actuator to control mechanical output.

**Fuzzification** -- The process of translating analog input variables to input memberships or labels.
**Fuzzy logic (FL)** -- Software design based upon a reasoning model rather than fixed mathematical algorithms; a FL design allows the automotive system engineer to participate in the software design because the fuzzy language is linguistic and built upon easy-to-comprehend fundamentals.

**Global time base** -- A clock or timing device relating to, or involving, the entire automotive vehicle network and providing the time base for the time-triggered protocol (TTP).

**Inference engine** -- The internal software program that produces output values through fuzzy rules for given input values; the inference process involves three steps: fuzzification, rule evaluation, and defuzzification.

**Input memberships** -- The input signal or sensor range is divided into degrees of membership, i.e., low, medium, high or cold, cool, comfortable, warm, hot; each of these membership levels is assigned numerical values or grades.

**Local area network (LAN)** -- A local multiplex that can serve a variety of devices; typically in integrated unibody, space-chassis or body-over-chassis motion mechatronic control hypersystems, it is used for collecting data from sensors and controlling actuators for one host module.

**Master (node or module)** -- The master node and master module are used interchangeably and are defined as the device that controls the transfer of information on a multiplex network.

**Master-slave** -- A type of system whereby one node, a module, acts as a master or central unit and controls the actions of the other nodes designated as slaves or remote units.

**Microcontroller unit (MCU)** -- A semiconductor device that has a CPU, memory, and I/O capability on the same chip.

**Multiplexing** -- The process of combining several messages for transmission over the signal path; there are two widely used methods of multiplexing: time division and frequency division.

**Open-loop mechatronic control** -- A process within a mechatronic control system in which one or more input variables act on output variables based on the inherent characteristics of the mechatronic control system; an open loop is a series of elements that act on one another as links in a chain; in an open loop, only disturbances that are measured by the control unit can be addressed; the open loop has no effect on other disturbances.
**Output memberships** -- The output signal is divided into grades such as off, slow, medium, fast, and full-on; numerical values are assigned to each grade; grades can be either singleton (one value) or *Mandani* (a range of values per grade).

**PI controller** -- A controller with the proportional and integral characteristics.

**PID controller** -- A controller with the proportional, integral and derivative characteristics.

**Protocol** -- A formal set of conventions or rules governing the exchange of information (data) between nodes (networked elements), including the procedures for establishing and controlling transmission on the multiplex signal bus (message administration) and the organisation, meaning, and timing associated with the bits of data (message transfer).

**Pulse-width modulation (PWM)** -- The precise and timely creation of negative and positive waveform edges to achieve a waveform with a specific frequency and duty cycle.

**Rule evaluation** -- Output values are computed per the input memberships and their relationship to the output memberships; the number of rules is usually set by the total number of input memberships and the total number of output memberships; the rules consist of *IF* inputvarA is *x*, *AND* inputvarB is *y*, *THEN* outvar is *z*.

**Semicustom MCU** -- A microcontroller unit (MCU) that incorporates normal MCU elements plus application-specified peripheral devices such as higher-power port outputs, special timer units, etc.

**Time division multiple access (TDMA)** -- A general classification of multiplexing that uses time division multiplex protocol.

**Time triggered protocol (TTP)** -- A real-time mechatronic control system architecture where all system activities are triggered by the progression of real-time; this distributed time triggered architecture requires clock synchronisation by a global time base.

**Transceiver** -- An electrical circuit which both transmits (line driver portion and receives (line receiver portion).


References and Bibliography


73. Fruechte RD, AM Karmel, JH Rillings, NA Schilke, NM Boustany and BS Repa (1989): Integrated Vehicle Control. Proceed-


References and Bibliography


References and Bibliography


117. KOOPMAN JJ (2008): Passivity-Based Global Chassis Control. Delft University of Technology, Delft Center for Systems and Control, The Netherlands, PDF Paper, Email: j.j.koopman@tudelft.nl, 1 p.


136 References and Bibliography


170. ROPPENECHER G AND H WALLENTOWITZ (1993): Integration of chassis and traction control systems: What is possible - What makes sense -


Wilwert C, YQ Song, F Simonot-Lion and T Clément (2003D): Evaluating Quality of Service and Behavioral Reliability of Steer-by-Wire Systems. 9th IEEE International Conference on Emerging Tech-


