1 Glossary

According to *SAFEPROCESS* convention of the International Federation of Automatic Control, here the main notation and terminology used in the monograph are described. This convention is taken from Blanke et al. (2006) for fault diagnosis and control. The glossary for the degradation analysis is taken from Breton and Daigle (2019). One can also consult the references Puig et al. (2004a), Puig et al. (2004b) and Verde et al. (2013) for the notation in Spanish.

Fault Detection

- **Abrupt fault**: Fault with effects that appear suddenly. An example is a fault modeled by a discontinuous function.
- **Discrepancy:** An abnormal behavior of a physical value or inconsistency that alter physical values and the relationship between them.
- **Failure:** Permanent interruption of a system's ability to perform a required function under specified operating conditions.
- **Fault:** Unpermitted deviation of at least one characteristic property or one system parameter from its standard condition.
- **Fault detection:** Determination of faults present in a system and time of detection.
- **Fault diagnosis:** Determination of kind, size, location, and time of occurrence of a fault. Fault diagnosis includes fault detection, isolation and estimation.
- **Fault effect analysis:** Study of the fault consequence and its is propagation throughout the system.
- **Fault estimation:** Calculation of the size and behavior of a fault over the time.
- **Fault isolation:** Determination of kind, location and time occurrence of a fault. It follows fault detection.
- **Fault mode:** Particular way in which a fault can occur. Each fault usually has associated specific effects.
- **Fault modeling**: A quantitative or qualitative mathematical model that describes the fault behavior.
- **Incipient fault:** A fault with effects that occur in a progressive way. As example, a fault modeled by a time function started with very small deviation from 0 as a ramp.

Fault Diagnosis

- **Analytical redundancy**: The use of two o more, but not necessary identical, ways to determine a variable, where one way uses a mathematical process model in analytical form.

- **Redundancy:** The existence of more than one set of components or data to know the status and characteristics of a system.
- **Hardware redundancy:** The use of two o more independent devices or instruments to estimate a specific function.
- **Residual**: Signals carrying fault information based on a deviation between measurement and model-based computations. A residual describes a degree of consistency between the real and modeled system.
- **Residual evaluation:** Analysis of the residue in order to detect, isolate or identify faults.
- **Residual generation:** algorithm to determine a residual from the known measurements and system's model.
- **Threshold:** Limit value of a residual deviation, so if it is exceeded, a fault is declared. It denotes the residual value from which the existence of the fault is considered.
- **Vote:** Decision-making process based on joint indicators for a fault diagnosis.

Supervision

- **Monitoring:** It is the function of a real-time continuous record system, which can analyze a process's behavior to indicate anomalies. Another term used for this concept is **surveillance** and state observation.
- **Plant-wide supervision**: It is the activity that ensures that the trajectories of the important variables of a process follow the reference trajectories in an adequate way. This terminology is frequently used for a global supervision.
- **Supervision:** Monitoring of a physical system and taking appropriate actions to maintain the operation in the case of faults.
- **Supervisor:** Human or artificial operator who performs the supervision tasks by using fault diagnostic systems, determines the fault and performs corrective actions in the presence of faults.
- **Supervisory:** A function that performs supervision by results of fault diagnosis determines remedial action when needed and executes corrective actions to handle faults. This definition is also used for local supervision.

Fault-Tolerant Control

- **Active fault-tolerance control:** A control system where the faults are explicitly detected and accommodated. This feature is opposite of a passive fault-tolerant system.
- **Admissible control laws**: Set of algorithms that can be implemented to solve a certain control problem in fault condition.
- **Control objective:** Formulation of a certain control task by using requirements and assumptions for the system variables.
- **Control constraints**: Set of functional relations that must satisfy a device or system imposed by physical law or natural laws. It permits the variables to take certain values in the variable space.
- **Fault accommodation:** A change in the system's behavior such that a fault does not produce an undesired failure, and it is implemented in the two forms below:
  - A corrective action based on a system operation change avoiding that a certain failure leads to an undesired final effect.

  - An adjustment on the parameters of the control law to avoid the fault effects. In general the input and output of the controller remains the same, and the control objective is achieved even with a degraded performance.

- **Fault-tolerance system**: A systems where a fault is accommodated with or without performance degradation, and a singles fault does not develop into a subsystem or system failure.
- **Passive fault-tolerance:** A system where faults are not explicitly detected and accommodated, but the controller is designed to be insensitive to a certain set of faults.
- **Reconfiguration:** A change in the input and output of the controller by changes in the structure or its parameters, but the control performance could be degraded.
- **Standard control problem:** It consists of the selection of a control law within an admissible set such that the system satisfies the control objective, and, at the same time the physical constraints are not violated.

Failure Prognosis

- **Monotonicity:** A metric that quantifies the monotonic trend in a prognostic feature as the system evolves toward the failure state.
- **Prognostics:** Estimation of the current system state, and future load and uncertainty. This task predicts at what time a component will reach an specific state.
- **Prognosability:** A metric of the variability of a feature at failure based on experiments.
- **Remaining Useful Life:** Time from the current instant to the time of failure or system health loss. Some authors consider the remaining time to replace or repair a component.
- **Trendability:** A metric of the similarity between trajectories of a feature by several run-to failure experiments.

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References

Blanke, M., Kinnaert, M., Lunze, J., and Staroswiecki, M. (2006). *Diagnosis and Fault Tolerant Control*. 2nd. Ed. Springer, Berlin.

Breton, A. and Daigle, M. (2019). *Fault Diagnosis of Dynamic Systems*, chapter Fundamentals of Prognostics, pages 409–432. Springer, Berlin.

Puig, V., Quevedo, J., Escobet, T., Morcego, B., and Ocampo, C. (2004a). Control tolerante a fallos (parte i): Fundamentos y diagnóstico de fallos. *Revista Iberoamericana de Automática e Informática Industrial*, 1(1):15–31.

Puig, V., Quevedo, J., Escobet, T., Morcego, B., and Ocampo, C. (2004b). Control tolerante a fallos (parte ii): Mecanismos de tolerancia y sistema supervisor. *Revista Iberoamericana de Automática e Informática Industrial*, 1(2):5–25.

Verde, C., Gentil, S., and Morales-Menéndez, R. (2013). *Monitoreo Y Diagnóstico Automático De Fallas En Sistemas Dinámicos*. Trillas.