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*"La mente è come un paracadute.
Funziona solo se si apre"*

A. Einstein

Advanced new results in classical automatic control and network theory

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Abstract

The aim of this lecture is to give some advanced new results both regarding classical control theory and network design recently obtained. It could appear that all the problems of the linear time invariant systems had been solved. After the "age of robust control" it could appear that more problems were extinguished. It has not been so. The possibility of having analytical solutions in closed loop form of a new class of problems has been approached. Moreover the link between classical automatic control and network design will be emphasized. In summary the following problems and the referring solutions will be given.

- Passification of systems by using forward control.
- Frequency transformations and invariants of linear time invariant systems.
- Forward action to make imaginary negative systems.
- Forward actions to make time delayed system positive real.
- The Nyquist diagrams of SISO and MIMO systems under frequency transformation.
- Cascade systems with inner and co-inner systems: the singular values and the characteristic values trends.

The theoretical results of the previous items are of wide applications in VLSI analog circuit design. The aim of this research is double, both to prove further advanced properties in classical control theory and to avoid that the new and actual appealing trends in automatic control theory leads to forget the classical fundamental principles that allows the main guidelines both in industrial and in system's engineering.

The seminar is self contained. In the first part the essential definitions will be given. The second part will be organized in order to explain the main results without demonstrations. The third part will regard the strongly hidden links among the outline items. The following reference books will be reported. The list of the specific authors papers will be furnished during the lecture.

- [1] Antonio Ruberti, *Lezioni di Controlli Automatici*, Siderea Roma 1971.
- [2] Giuseppe Martinelli, *Teoria delle Reti Elettriche*, Siderea Roma 1970.
- [3] Brian D.O. Anderson, S. Vongpanitlerd, *Network Analysis and Synthesis*, Dover N.Y 1973.

Joint work with M. Bucolo, A. Buscarino, and M. Frasca, DIEEI Università di Catania

Venerdì 18 settembre 2020, ore 15:00