Postscriptum – A Personal Point of View

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Impressed by the elegance and simplicity of the Popov frequency criterion and the concept of hyperstability, I have joined in October 1967 (for one year) the group of V. M. Popov at the Energy Institute of the Romanian Academy with the objective to apply the Popov theory to adaptive systems and real-time identification.

From the interpretation of the Popov stability criterion in terms of an equivalent feedback system formed by two passive blocks (one being strictly passive) and several discussions with V. M. Popov, I have realized that the challenge is to find an equivalent feedback representation as a combination of two blocks and render by design these two blocks passive. A number of developments in the field of adaptive systems and recursive identification followed this path.

However, from the discussions with V. M. Popov and my own investigations, it was also clear that many stable solutions for a variety of control problems admit an equivalent feedback representation formed by two passive blocks and, therefore, satisfying the now well-known passivity theorem. I have called this equivalent representation the “hidden” Popov feedback system.

Since then I have systematically tried to promote the interpretation of the various results in adaptive control or in the stabilization of classes of nonlinear systems in terms of an equivalent feedback system formed by two passive blocks. Of course, various generalizations of the Popov–Yakubovich–Kalman lemma have been useful [3,4,5,6].

The papers [1,2,8,11,14] constitute an incomplete list of papers concerned with this interpretation. In particular, several backstepping designs have equivalent feedback interpretations [7] as well as the high order tuners and back stepping adaptive controllers for linear systems with relative degree superior to 3 [2,12,13]. Similarly, adaptive control schemes used in robotics admit an equivalent feedback representation [1,9,10,15].

Such interpretations are in my opinion important because they show the wide impact of passivity (and dissipativity) concepts in control (even if in many cases “passivity” is hidden).

I am very pleased today that we have been able to prepare a special issue dedicated to V. M. Popov. On a personal side, my implication in this project is a tribute to V. M. Popov for the intellectual impact he had on the orientation of my research activity.

References

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