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Polynomial and rational matrices with the invariant rational functions and the 4 sequences of minimal indices prescribed

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The complete eigenstructure, or structural data, of a rational matrix R(s) is comprised by its invariant rational functions, both finite and at infinity, which determine its finite and infinite pole and zero structures, and by the minimal indices of its left and right null spaces. These quantities arise in many applications in control theory and have been thoroughly studied in numerous references. However, R(s) has other two fundamental subspaces which, in contrast, have received much less attention in the literature. They are its column and row spaces, which also have their associated minimal indices. This work solves the problems of finding necessary and sufficient conditions for the existence of rational matrices in two scenarios: (a) when the invariant rational functions and the minimal indices of the column and row spaces are prescribed, and (b) when the complete eigenstructure together with the minimal indices of the column and row spaces are prescribed. The particular, but extremely important, cases of these problems for polynomial matrices are solved first and are the main tool for solving the general problems.

This is a joint work with Itziar Baragaña, Silvia Marcaida and Alicia Roca.

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