

A Small Gain Theorem for Well-Defined but Not-Necessarily Well-Posed LTI Systems

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A stable open loop with gain below unity remains stable under negative feedback. This is the essence of the small gain theorem. The latter is known in many forms, ranging from scalar linear time-invariant systems with rational transfer functions to multivariable non-linear time-varying systems. The small gain theorem has been studied extensively. However, existing results do not address linear time-invariant systems with closed-loop sensitivities that are well-defined but not necessarily proper. While such systems are not physically realisable, they arise naturally as modelling artefacts in electrical network analysis. We present a variant of the small gain theorem tailored to this setting and provide some insight on how to prove it correct.