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The conjugate of a product of linear relations

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Abstract: Let X, Y and Z be normed linear spaces with $T(X \to Y)$ and $S(Y \to Z)$ linear relations, i.e. setvalued maps. We seek necessary and sufficient conditions that would ensure that $(ST)' = T'S'$. First, we cast the concepts of relative boundedness and co-continuity in the set valued case and establish a duality. This duality turns out to be similar to the one that exists for densely defined linear operators and is then used to establish the necessary and sufficient conditions. These conditions are similar to those for the single valued case. In the process, the well known characterisation of relativeboundedness for closed linear operators by Sz.-Nagy is extended to the multivalued linear maps and we compare our results to other known necessary and sufficient conditions.

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