An efficient network reduction method for transmission expansion planning using multicut problem and Kron reduction

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Abstract— This article provides a new methodology to compute a reduced but accurate network representation in a Transmission Expansion Planning (TEP) context. Considering this reduced
network should lead to the same investment decisions as if the whole original network were considered. A set of relevant lines to be preserved is defined based on a proxy of the TEP solution. An optimal network partition, resulting from solving the multicut problem, is computed in such a way that the two ends of each of these relevant lines are allocated to two different areas. An iterative Kron reduction is then applied to each area to eliminate most of the buses that are not connected to any inter-area line. This two-step process results in a compact but representative reduced network. Our algorithm has been implemented in General Algebraic Modelling Software (GAMS) and Matrix Laboratory (MatLab) and has been tested on the standard IEEE 118 bus system and a case study based on the European power system. The method produces very promising results and, in the considered case studies, leads to the same, or equally efficient, investment decisions and essentially the same total costs as when considering the whole original network.

Index Terms— Clustering, Dimension Reduction, Integer linear programming, Network theory (graphs), Partitioning algorithms, Transmission Expansion Planning, Relaxation methods