Design of Robust Global Power and Ground Networks

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We consider the problem of determining optimal wire widths for a power or ground network, subject to limits on wire widths, voltage drops, total wire area, current density, and power dissipation. To account for the variation of the current demand, we model it as a random vector with known statistics, possibly including correlation between subsystem currents. Other researchers have shown that when the variation in the current is not taken into account, the optimal network topology is a tree. A tree topology is, however, almost never used in practice, because it is not robust with respect to variations in the block currents. We show that when the current variation is taken into account, the optimal network is usually not a tree. We formulate a heuristic method based on minimizing a linear combination of total average power and total wire area. We show that this results in designs that obey the reliability constraints, occupy small area, and most importantly are robust against variations in block currents. The problem can be formulated as a nonlinear convex optimization problem that can be globally solved very efficiently.