Problem Submission for PIMS 7th Industrial Problem Solving Workshop

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Modern integrated circuits (ICs) consist of an active transistor layer built in a silicon substrate and multiple discrete metal wiring layers, built above the silicon level and isolated from each other by an insulating dielectric. The wiring layers are used for signal routing and power distribution. Vertically adjacent wire layers are connected by openings in the insulating dielectric layer ("vias"). Modern ICs may have up to ten layers of interconnect and up to a kilometer of metal routing.

At the abstract design level the wiring layers and vias are represented using two dimensional polygons. The wiring layers consist of long sequences of interconnected polygons.

A significant problem is the detection of design faults in the wiring layers.

A major design fault is the inadvertent connection of power and ground nets (a short circuit) by errant metal or via polygons. The power and ground nets are necessarily distributed throughout the entire IC. The nets typically use an orthogonal layout, lines run either vertically or horizontally within a layer. Power and ground nets also normally use a tree type distribution structure, although some designs use a grid layout.

A connection between the power and ground terminals of an IC can be detected by polygon tracing from one terminal to the other but due to the complexity of the power and ground nets the exact location of the connection is difficult to localize. Tracing will only show that the two terminals are connected but it cannot show where they are connected since individual polygons do not carry any identifiers. Power and ground polygons can only be identified from their connection to their respective terminals. If the power and ground lines are connected then the identity of a polygon is ambiguous.

We are interested in methods to localize inadvertent power / ground connections.

The current approach involves strategically cutting away portions of the metal layout and re−running polygon tracing to determine if the cut has eliminated the defect. This allows localization of the short but is time consuming.