Pattern Matching Through Focus for Double Patterning Decomposition
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Motivation
- A good through-focus model for lateral influence pattern matching has applications in:
  - Double patterning
  - Interconnect variation
  - Standard cell placement

2009 Main Objectives
- Fast-CAD for full process window characterization of double patterning and guidance during decomposition
  - Use Pattern Matching with physically based models to assess post-decomposition through-focus window image weakness and combine results with other tools in state dependent learning of various resist definitions

The Problem
- Pattern matching has been found to be accurate for coma.
- Since focus is a large, even aberration, pattern matching to date has not been as accurate.
- A new, improved model for using lateral influence pattern matching for focus is required.

The New Model: Theory
\[ E_{\text{match}}(x', y') = \frac{1}{2} \int \left| L(x, y) \right|^2 \delta(x - x') \delta(y - y') \, dx \, dy \]
- Including the quadratic term can increase the accuracy of the focus model used for pattern derivation.
- Focus is an even aberration, and produces an imaginary field at the wafer that does not add linearly to the existing field.
- Focus is a large aberration, and requires more accuracy to model its behavior.

Patterns for Defocus Pattern Matching
- After the expansion for \( I = EE^* \), we find that our matching patterns of interest are:
  - Match Factor (Z3)^2
  - 1/3 Match Factor (Z0)
  - 2/3 Match Factor (Z8)

Tool Improvement 1: SPLAT Cutlines
- The cutlines for corners were found not to be placed correctly in the automatically generated SPLAT files.
- Removing all corners and any other incorrectly generated SPLAT files improved results significantly.

Tool Improvement 2: Simulation Location
The difference in intensity with defocus was found to be very small at the default simulation location (the match location).
Using only 49 datapoints per cutline was creating noise; the number of datapoints was increased by a factor of ten.

Limits of New Model
- For defocus smaller than 0.06\( \lambda \) RMS, the change in intensity scales with defocus^2.

Double Patterning Example

Future Goals
- Examine the pre and post OPC accuracy of pattern matching for defocus.
- Reduce the number of patterns (and therefore match factors) required for pattern matching through focus.
- Complete a larger case study for pattern matching applied to double patterning.