

<unhack>

SEM Scan Layout Optimization

Scanning Electron Microscope

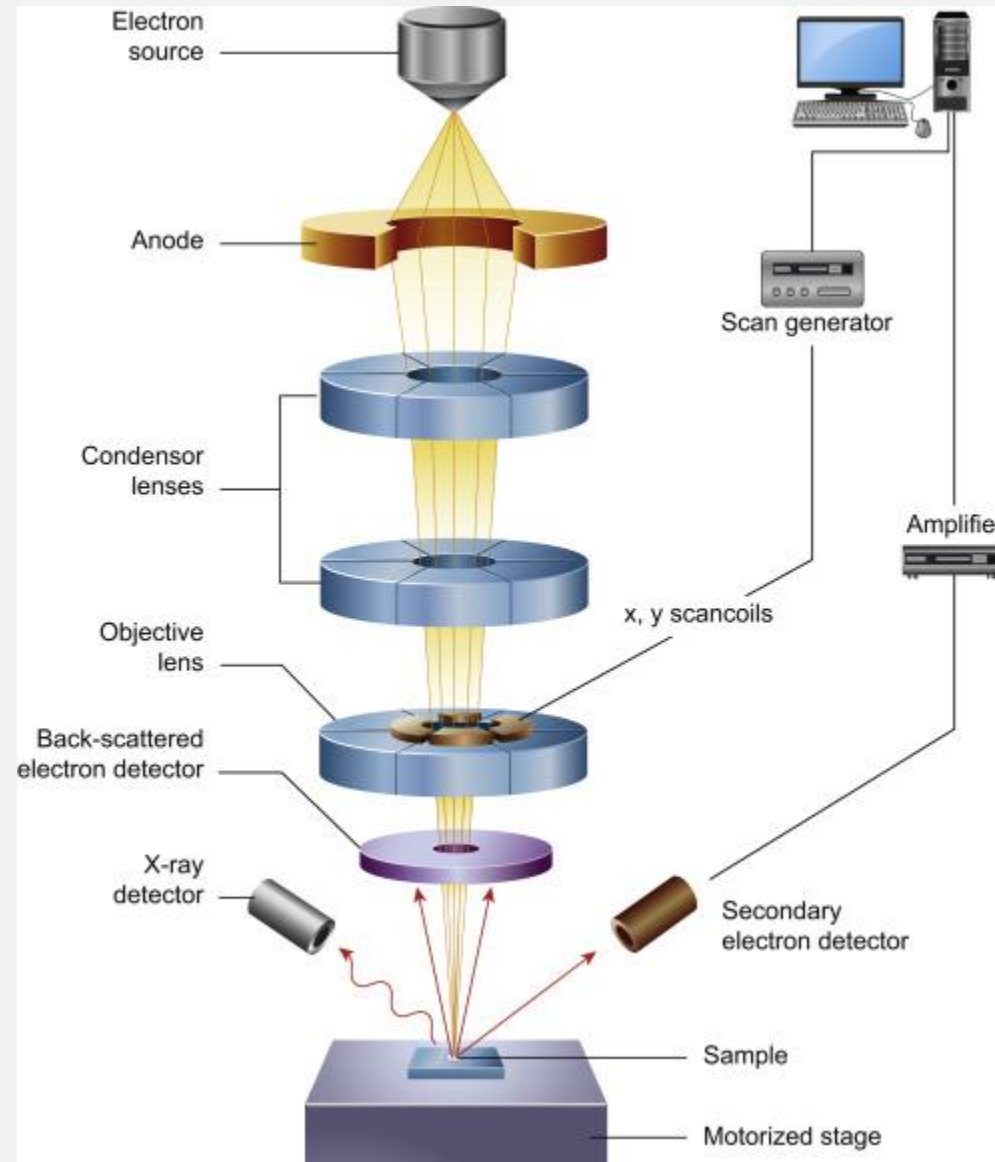


Image Source:
<https://www.sciencedirect.com/science/article/pii/B978008100040300002X>

SEM Images

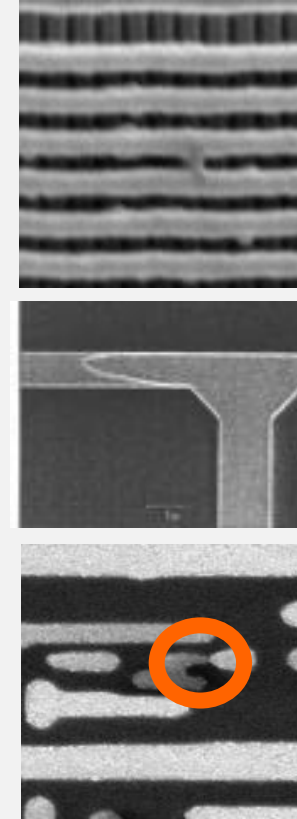
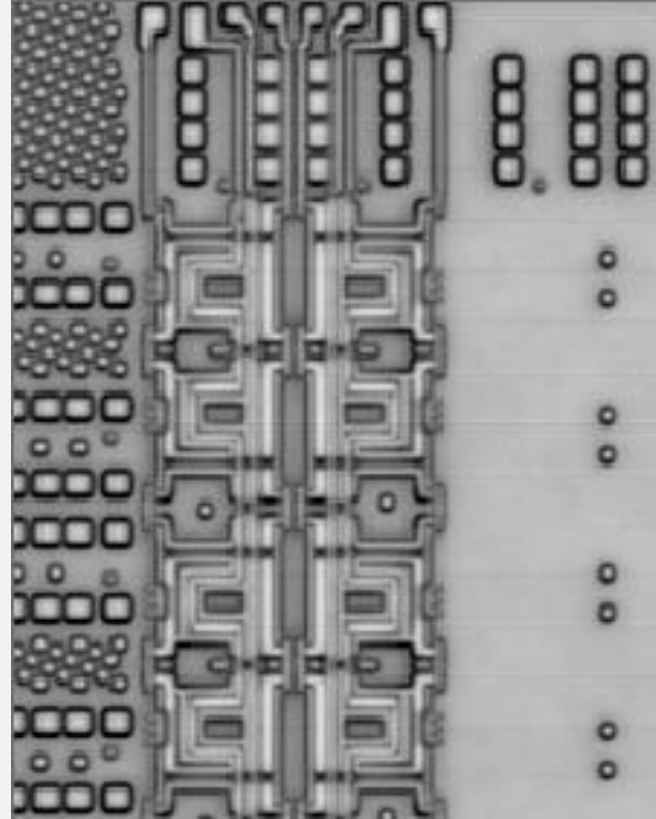
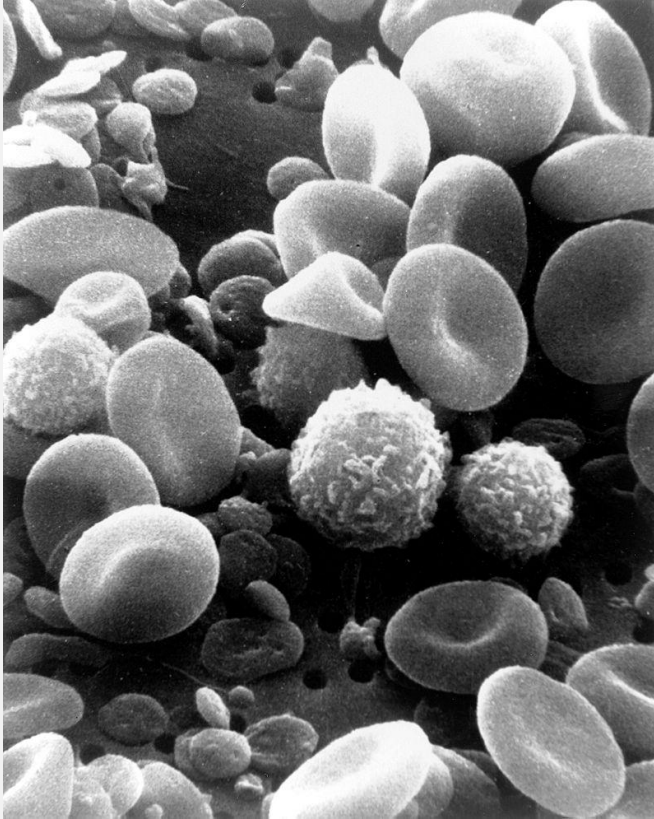
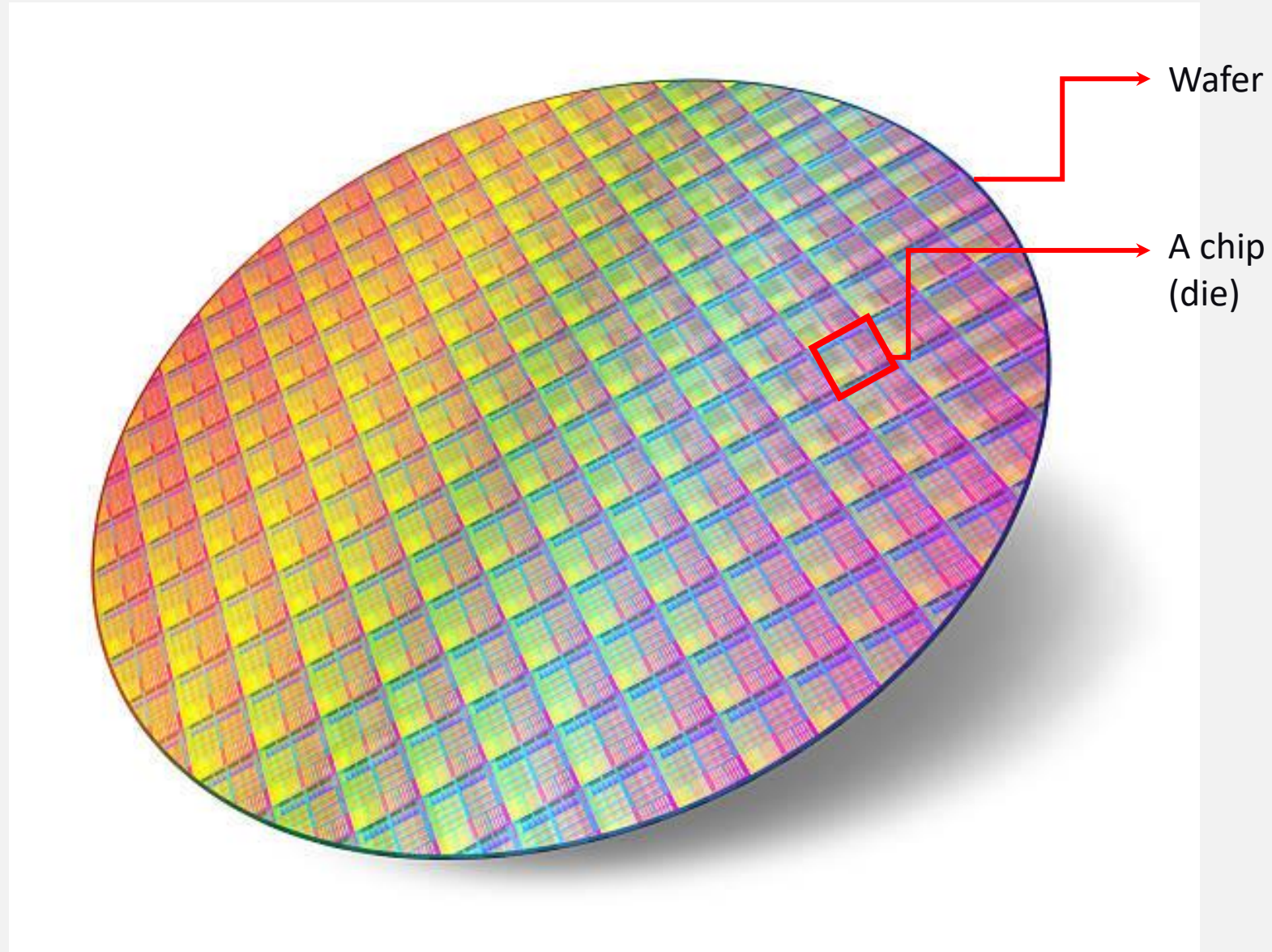
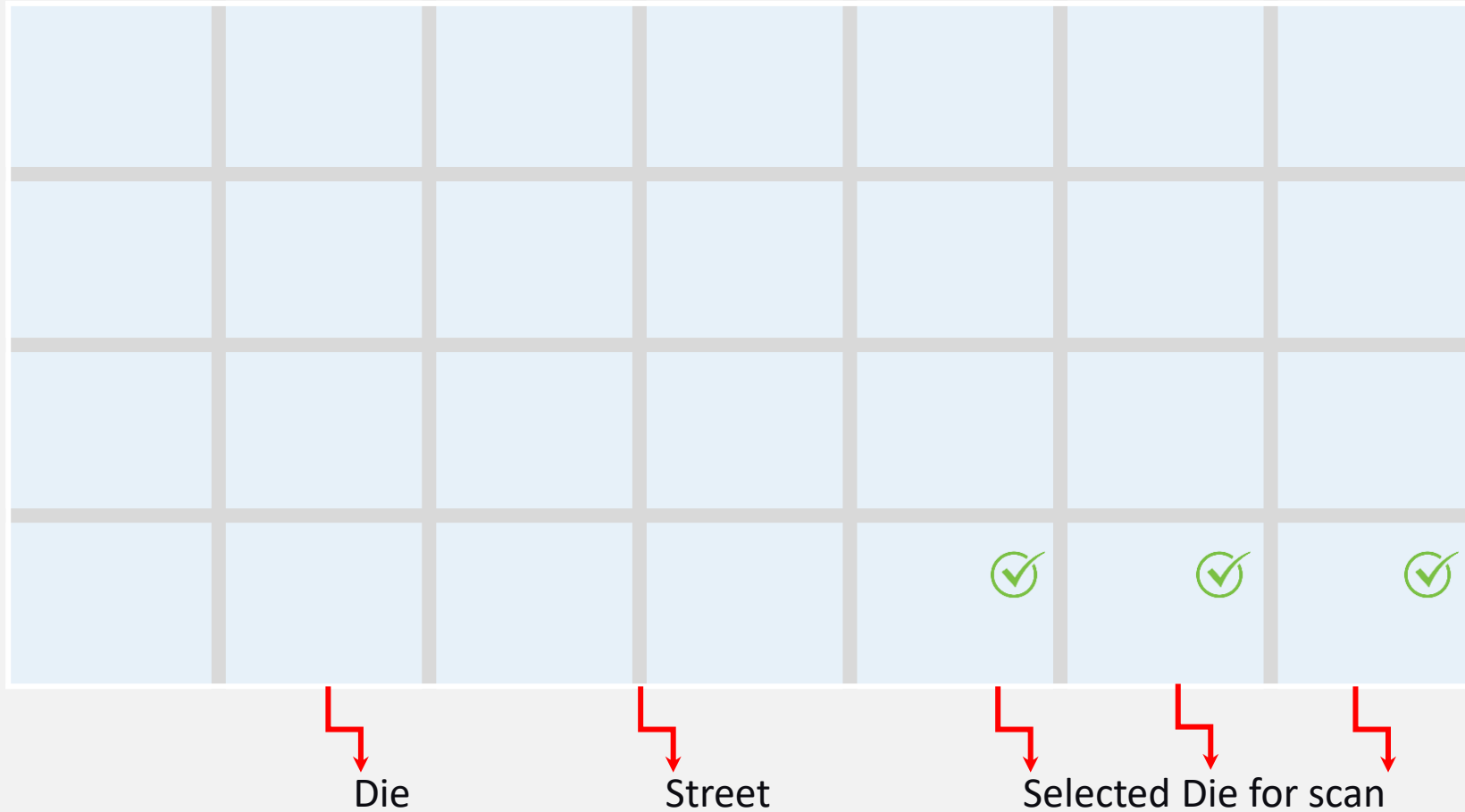


Image Source:
https://en.wikipedia.org/wiki/Scanning_electron_microscope

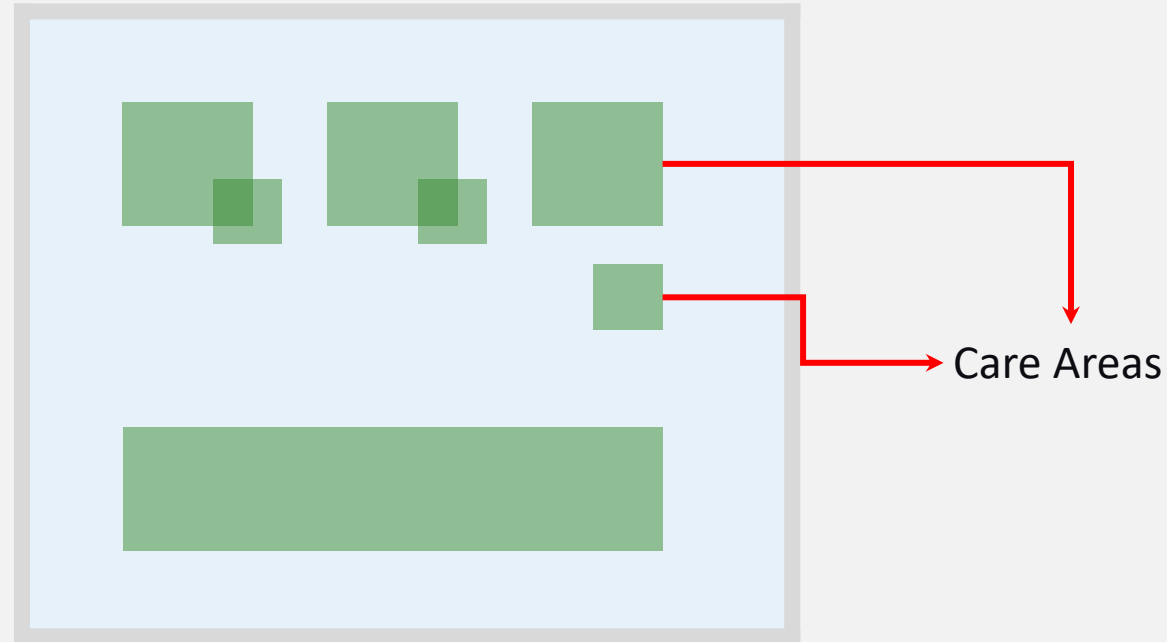
Scan Select Areas of Select Dies on the Wafer



Die Layout

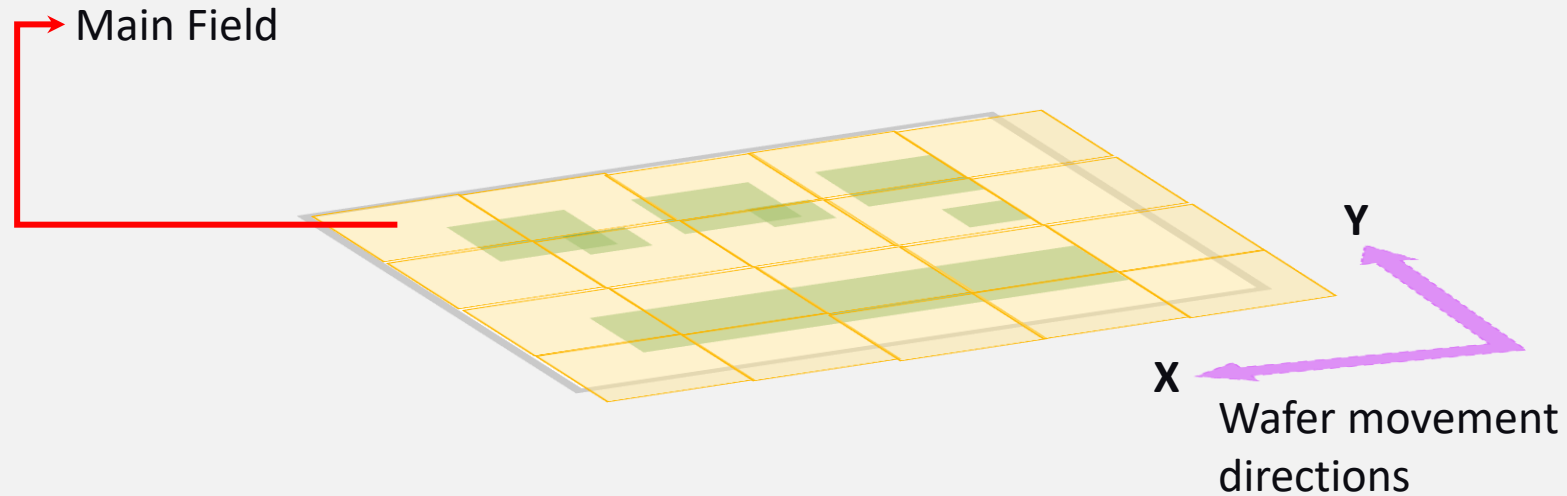


Care Areas in Die



Care Area: One or more rectangular areas of interest marked within a die to be scanned. Care area rectangles can overlap but the overlapped area should be scanned only once.

Move Stage to Scan The Die



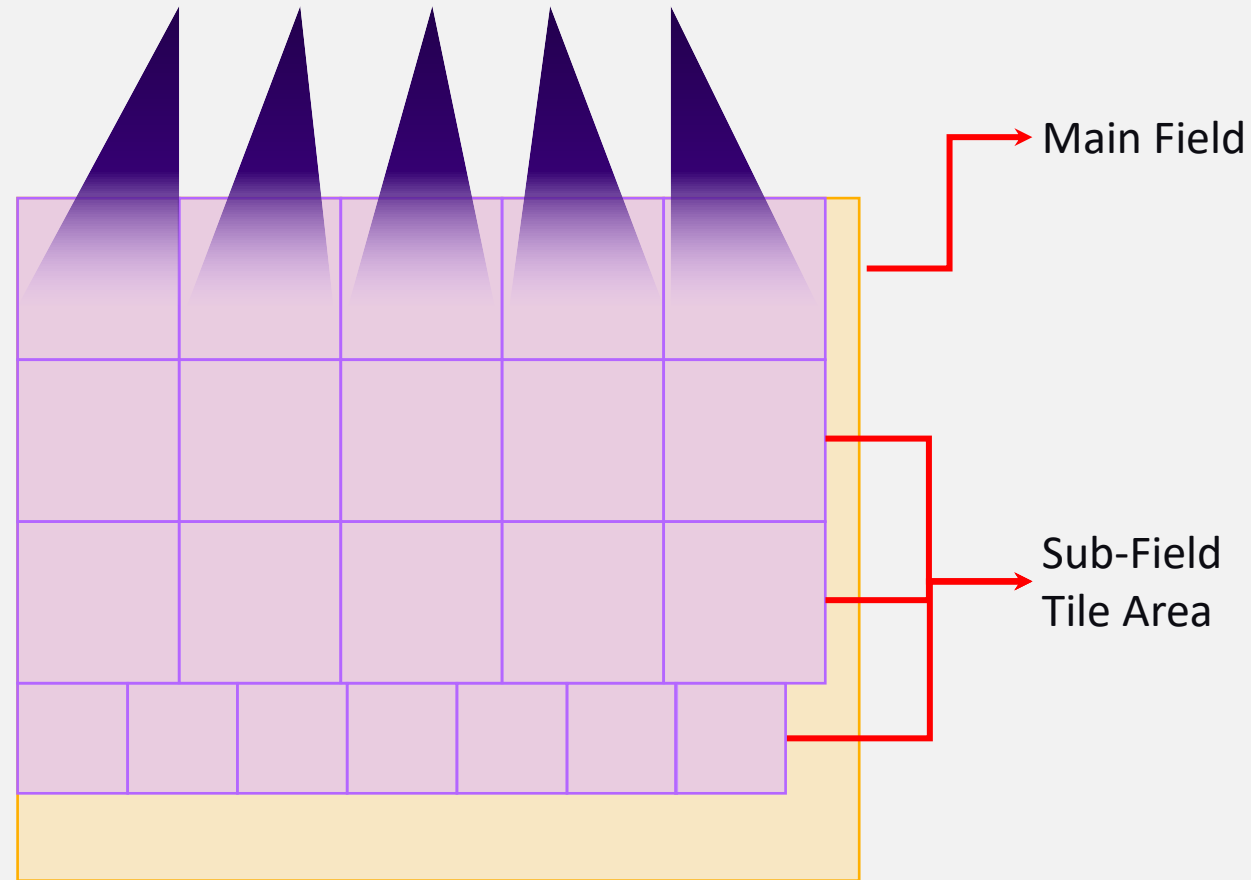
Main Field: Maximum area that can be scanned for a given stage position

Stage: Moves in X or Y direction only at a time.

Main Field & Sub-Field Coverage

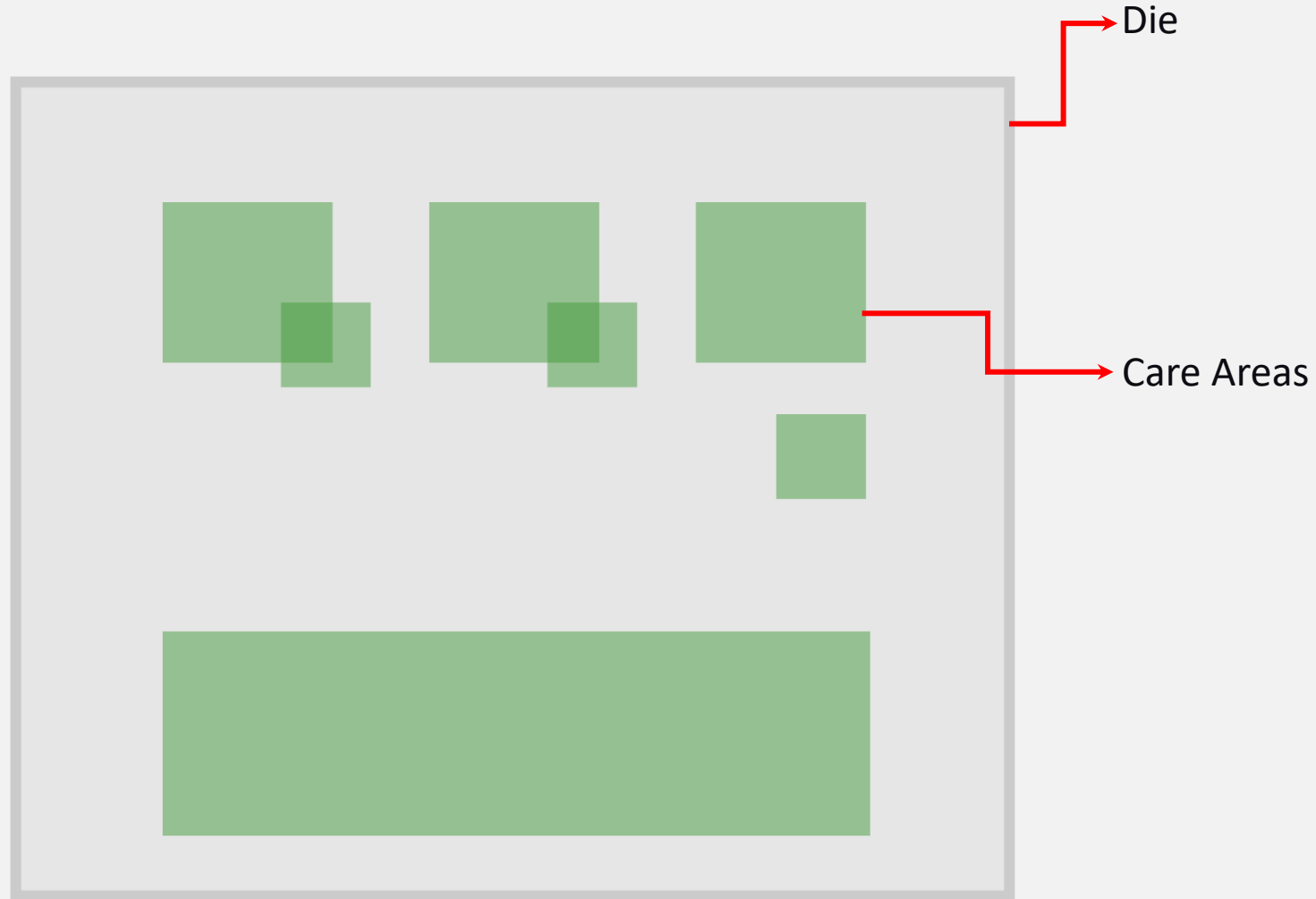


Main Field & Sub-Field Coverage

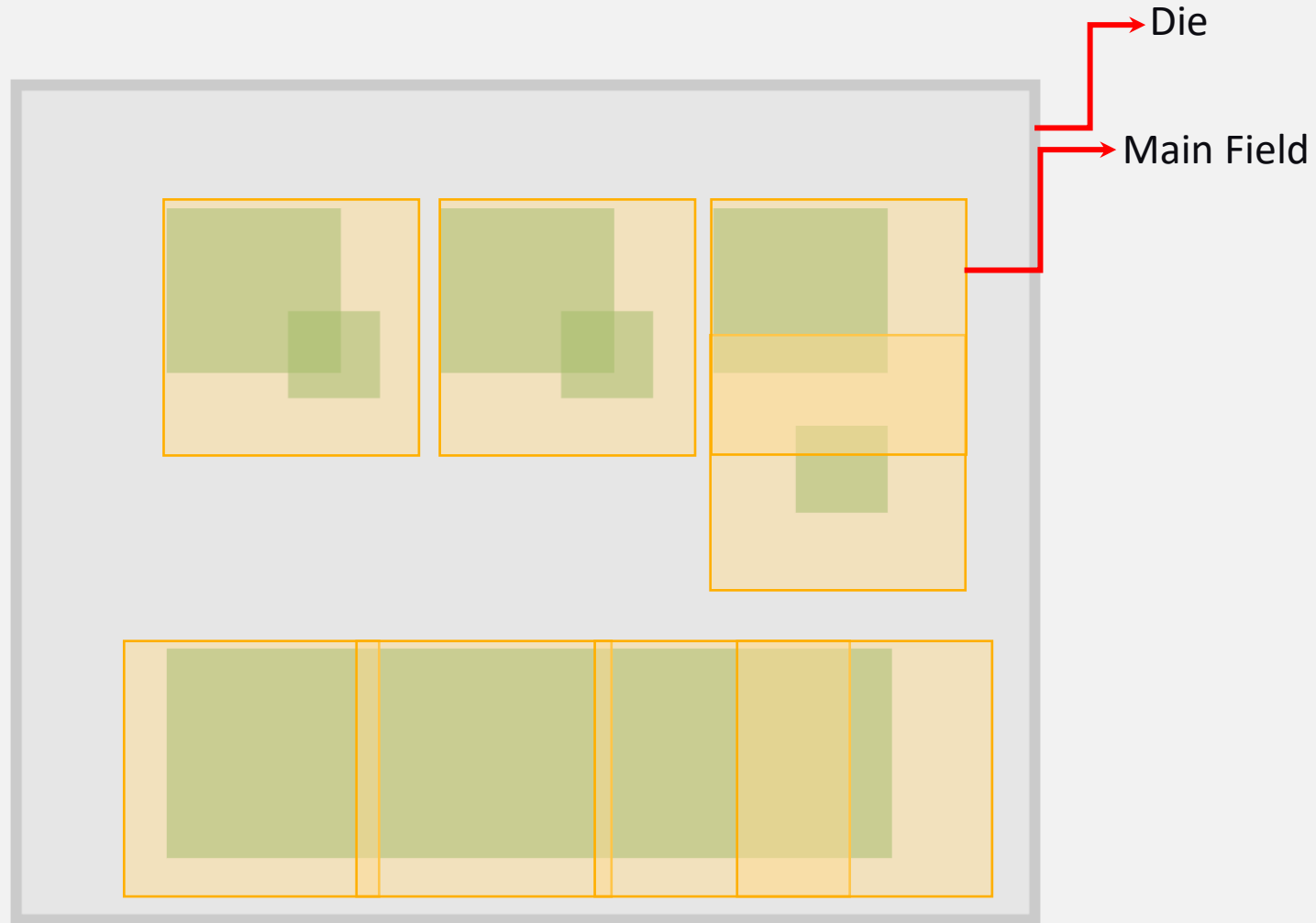


Sub-Field: A smaller tile area that can be scanned within a Main Field at a time. Sub-Field tiles within a Main Field can be scanned in any order as this does not involve physical stage move. Sub-Field size can be varied.

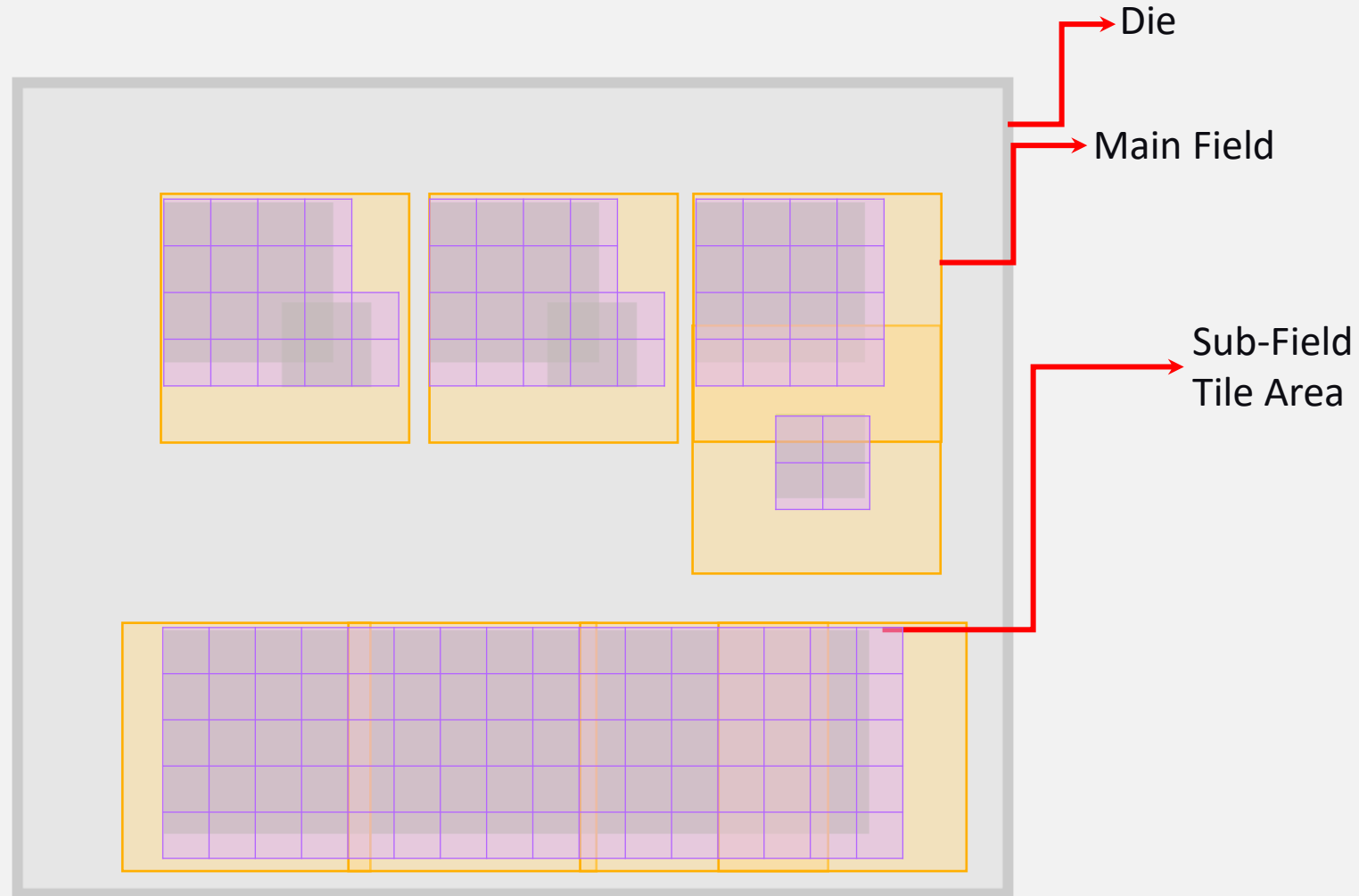
Multiple Sub-Field Sizes Based Optimization



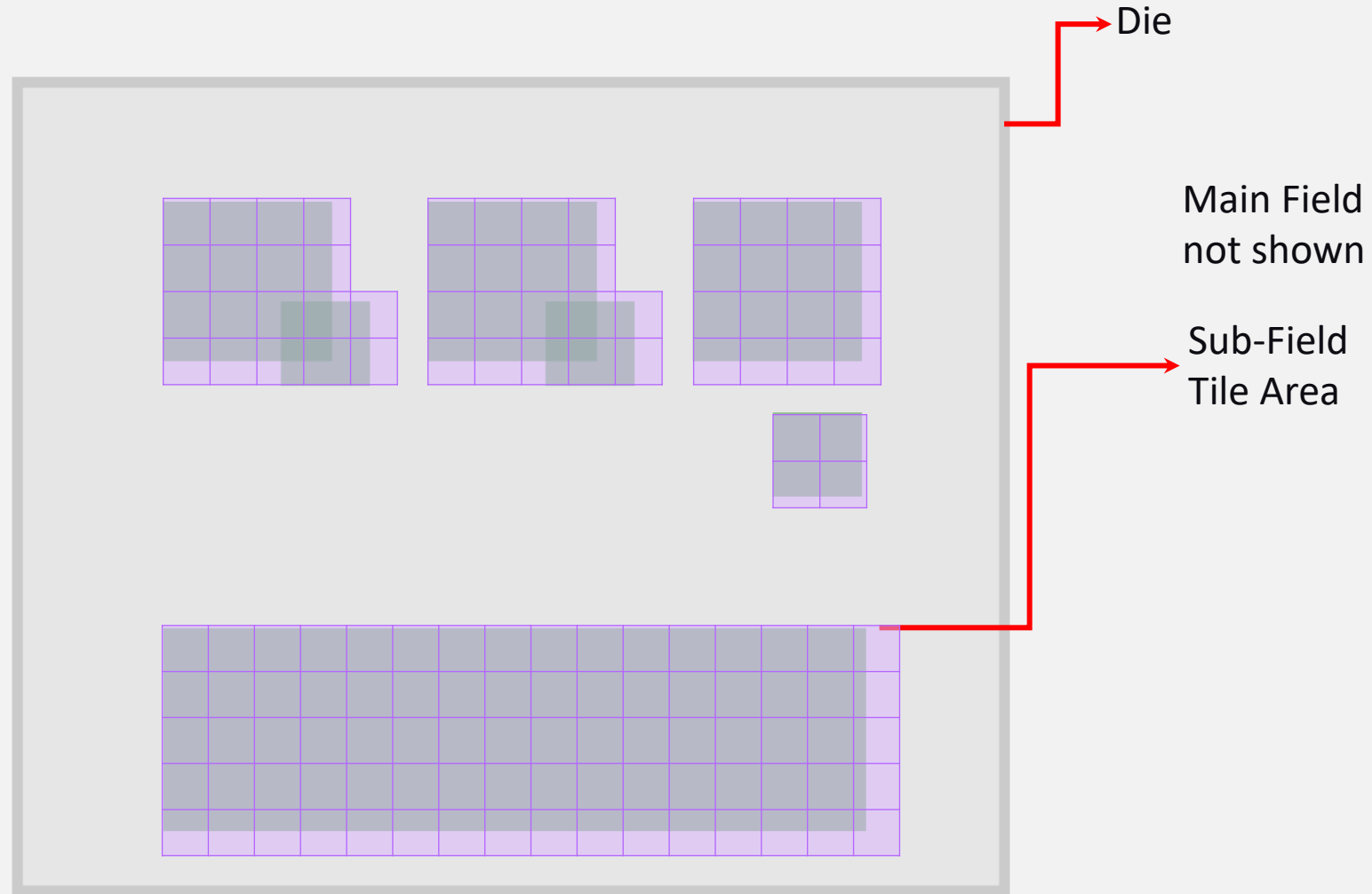
Multiple Sub-Field Sizes Based Optimization



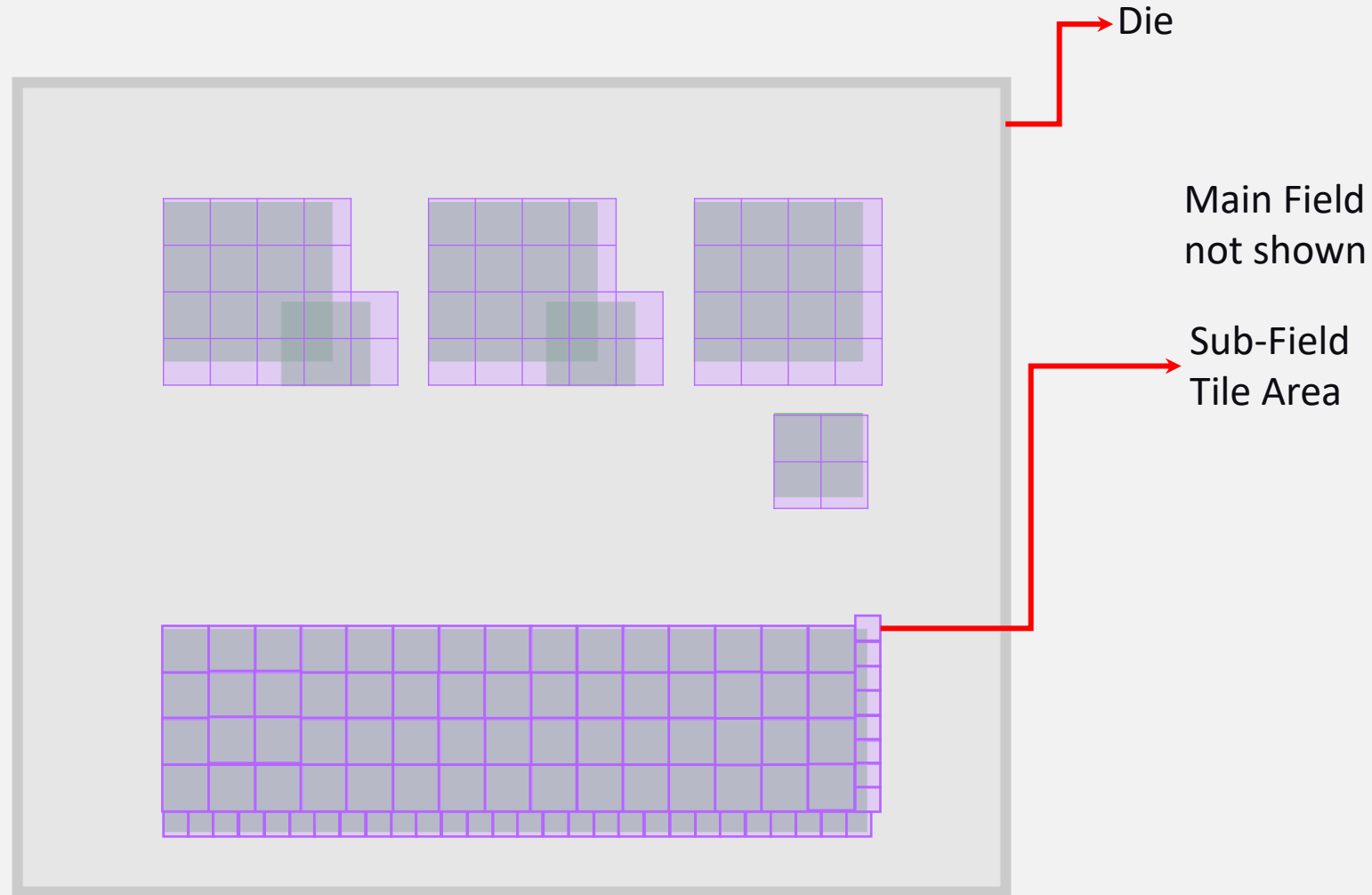
Multiple Sub-Field Sizes Based Optimization



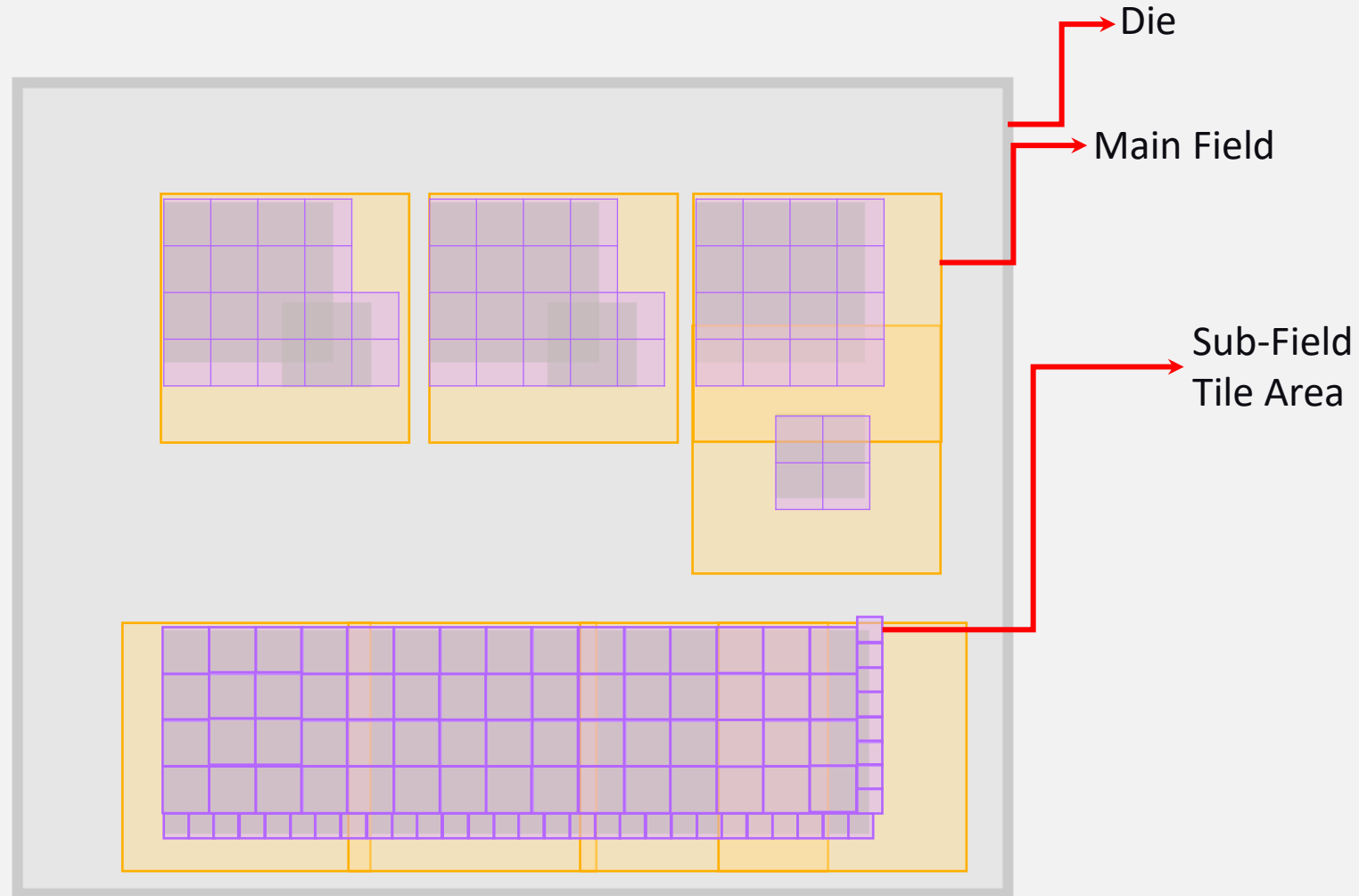
Multiple Sub-Field Sizes Based Optimization



Multiple Sub-Field Sizes Based Optimization



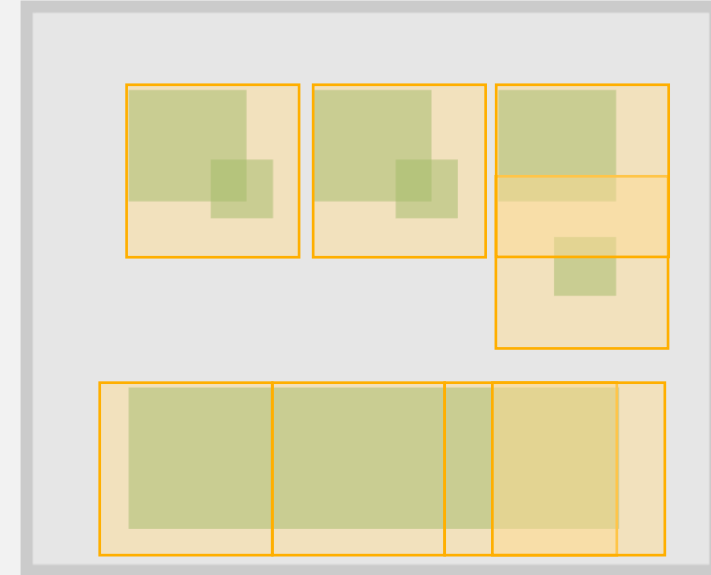
Multiple Sub-Field Sizes Based Optimization



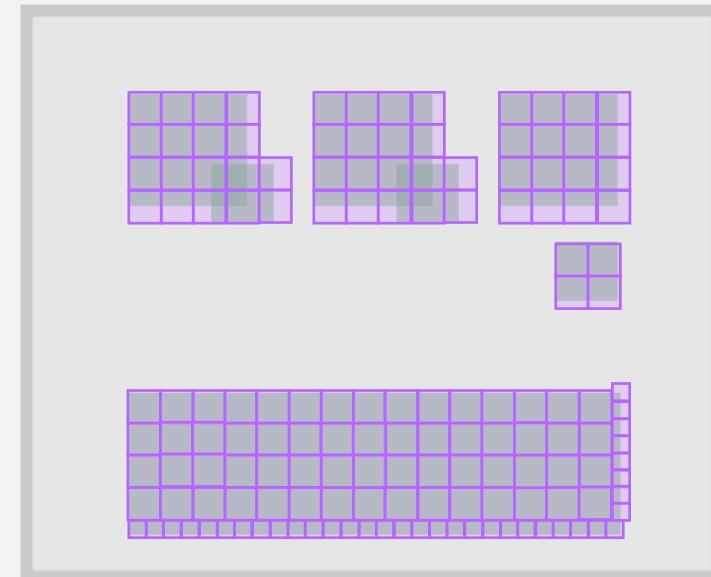
Problem Statement

- Given a set of care-areas within a die
- Generate placement of Main Field & Sub-Fields layouts
- Such that:
 - stage movement is minimized
 - no area is scanned a second time
 - scanning un-necessary area is minimized

Main Field Layout



Sub-Field Layout



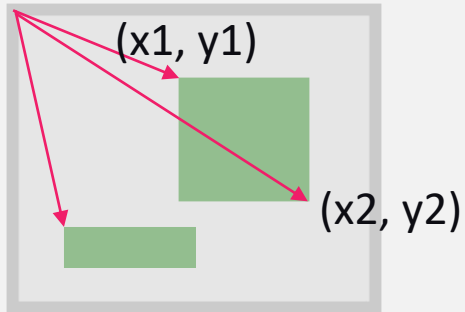
Main Field Layout Optimization Rules

- Main Field size is fixed (given as input)
- Use minimal number of Main Fields
- Main Fields can overlap with each other

Sub-Field Layout Optimization Rules

- Sub-Field size is smaller than the Main Field (given as input)
- Use minimal number of Sub-Fields to cover the care area
- Sub-Fields **cannot** overlap as this will cause repeated scan of the same area which will damage the wafer in that area
- Sub-Fields cannot extend beyond the Main Field
- Minimize the Sub-Field area extending outside the care area
- Some problem data-sets given allow for multiple sub-field sizes (given as input)

Coordinate System



- All units are in microns (μm)
- Coordinates of Care-Area, Main Field, Sub-Field are all relative to top left corner of the die
- X & Y coordinate values are always positive

Inputs Given

- CareArea.csv – List of Care Areas within one die.

For Example:

ID	x1	x2	y1	y2
0	6036.524	16765.762	6136.524	16865.762

ID is a unique serial number starting from zero

- MetaData.csv – Main Field and Sub-Field square's side (in μm)

For Example:

Main Field Size	Sub-Field Size
725.318	100
725.318	50

Output Expected

- MainFields.csv – List of Main Fields

For example:

ID	x1	x2	y1	y2
0	6036.524	6761.842	6136.524	6861.842

ID is a unique serial number starting from zero

- SubFields.csv – List of Sub-Fields

For example:

ID	x1	x2	y1	y2	MF ID
0	6040.444	6050.684	6140.444	6150.684	0

Milestones

- Sample: To familiarize with input and output format
- Milestone1 → Dataset\1st
- Milestone2 → Dataset\2nd
- Milestone3 → Dataset\3rd
- Milestone4 → Dataset\4th
- Milestone5 → Dataset\5th
- Milestone6 → Dataset\6th

Git: After each milestone completion and verification with mentors, upload to your personal git repo and share with “UnHack-2024” git ID

Evaluation Metrics (Visualizer Utility Provided)

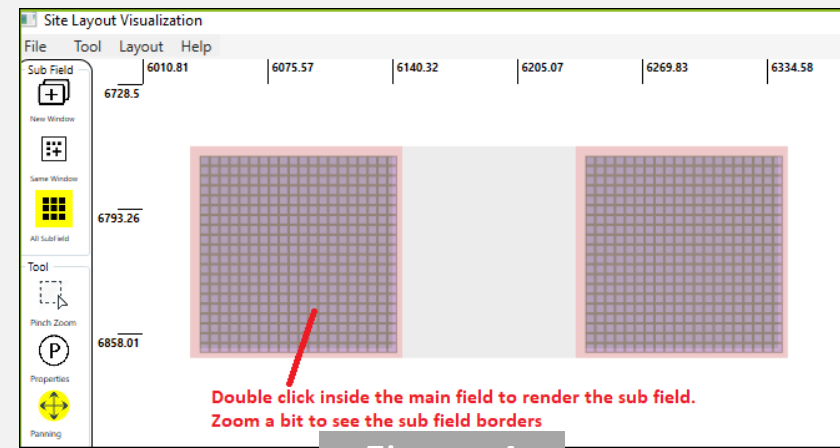
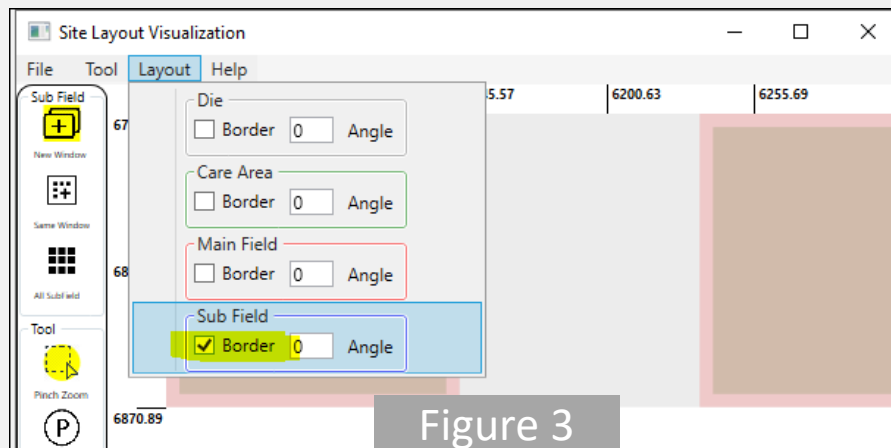
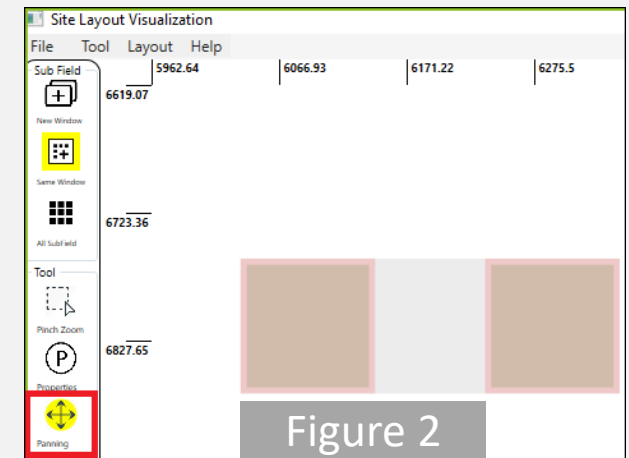
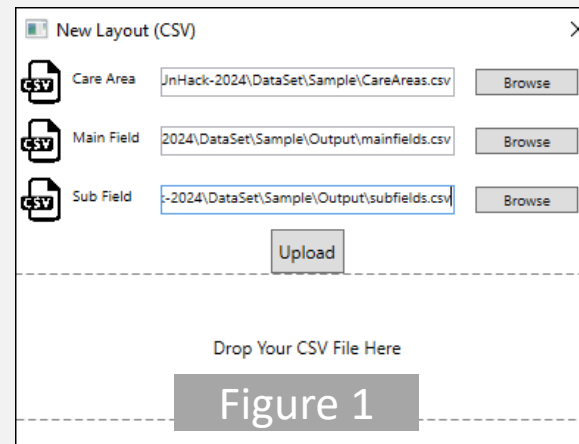


In priority order:

1. Area scanned more than once % (should be zero)
2. Extra Area Scanned % (minimal)
3. Care Area Coverage by Main Field % (full care area covered)
4. Care Area Coverage by Sub Field % (full care area covered)
5. Main Field Count (minimal)
6. Sub Field Count (minimal)

Visualizer

- Launch “SiteLayoutVisualizer.exe” from folder Visualizer\bin
- File -> Open
- Select careareas.csv from input folder and mainfields.csv, subfields.csv from results and click upload [Figure 1]
- Use Panning tool from Left tool bar to pan care areas, main fields and mouse scroll over the care areas to zoom in-out. [Figure 2]
- Enable SubField border from Layout menu [Figure 3]
- Enable AllSubFields from Left tool bar and double click inside main field in canvas to render sub field and then zoom a bit to see the sub field border [Figure 4]



Validator

- Inside the Validator\Students folder create folder matching your roll no [Figure 1]
- Inside roll no folder then further create MilestoneX (ex: Milestone1) folder and copy the input and output csv's into it [Figure 2]
- Run the validator command [Figure 3]
- Results.csv will be generated inside Validator\Results folder with below details [Figure 4]

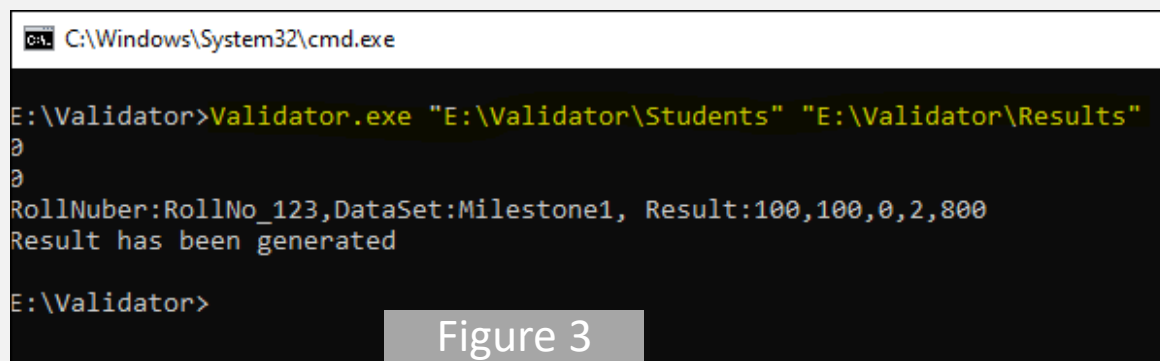
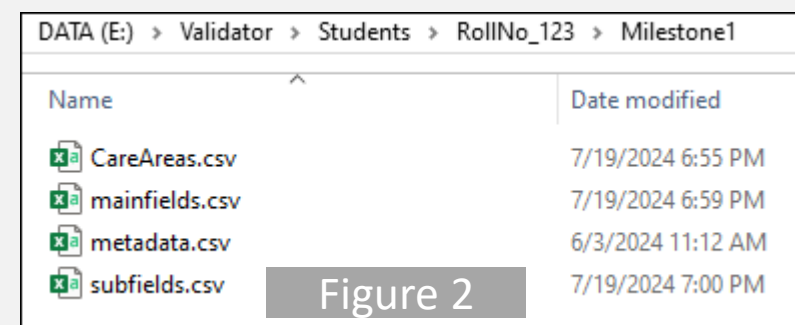
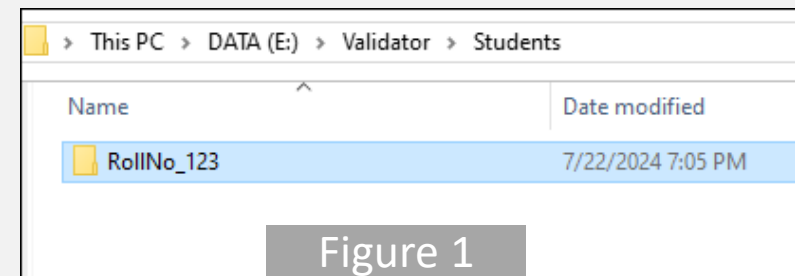


Figure 4

result.csv						
File	Home	Insert	Page Layout	Formulas	Data	Review
K18						
	A	B	C	D	E	F
1	RollNumber	DSNumber	MainFieldCoverage	SubfieldCoverage	ExtraScan	MainFieldCount
2	RollNo_123	Milestone1	100	100	0	2
3						

Q & A

All the best !