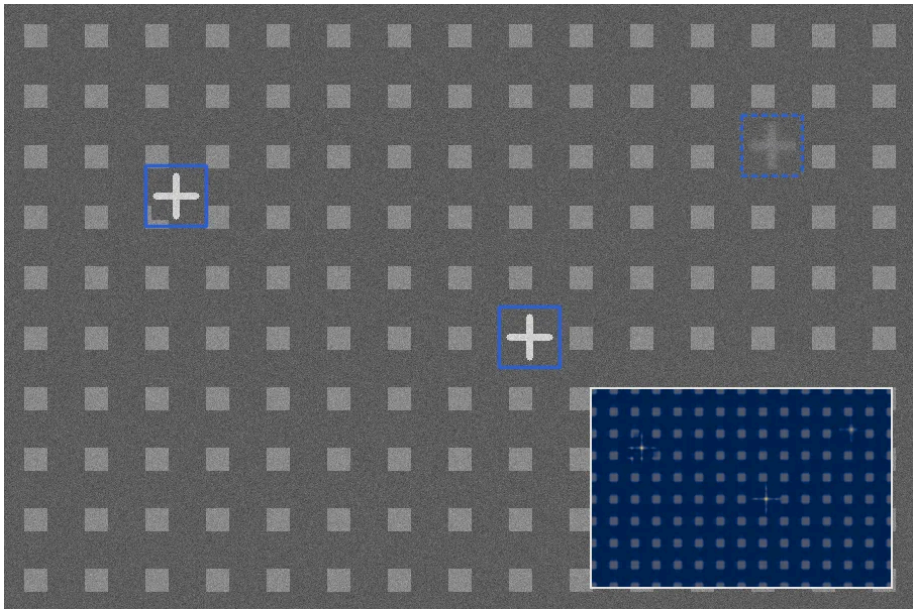
Shot Key alignment mark detection



Field alignment fell from **140 to 23 s**, with marks detected in **12/12** slots. CNN false detections fell from **280 to 114** on 6,150 in-house images including augmented examples.



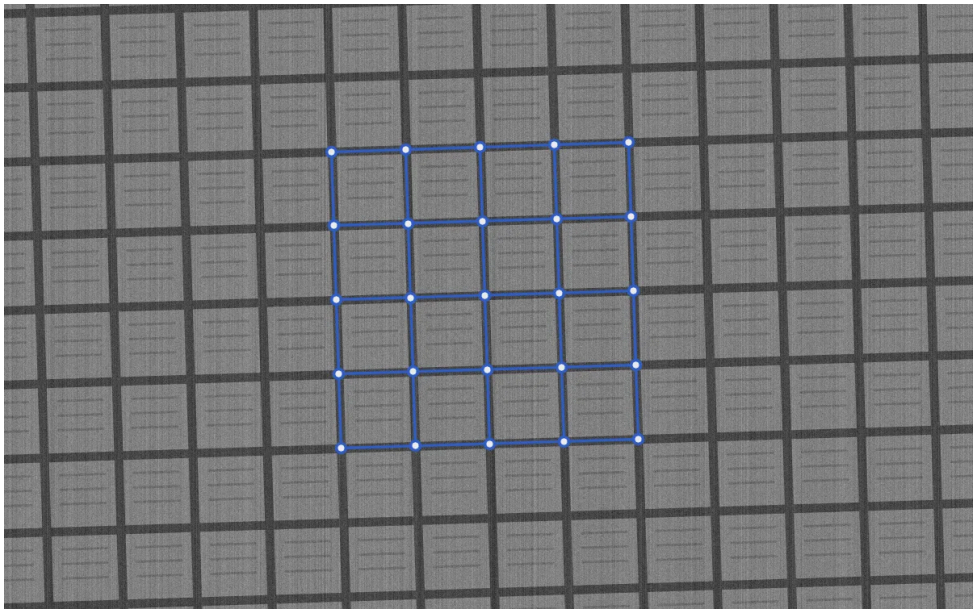
Rule detections (solid) and a faint mark missed by score (dashed); bottom right is the correlation map. Synthetic image

Problem	Template-based align was slow and needed marks re-registered at every new site. Rule parameters did not fit every image, causing false detections.
Implementation	Built a tool that learns the rule-detection tolerances people used to tune from labeled field images, and exports them as the profile file the tool reads. Import, auto-label and review, train and evaluate, and deploy all happen on one screen.
Evaluation	Mark detections on 1,030 unaugmented images rose from 996 to 998. This difference was not statistically significant.
Status	Rules passed field tests. The CNN runs in shadow alongside the existing decision.

Evidence · internal evaluation records (H1 2026), training tool documentation

Wafer alignment without registered features

False passes fell from **134 to 0** in 191 synthetic cases and from **31 to 0** in 48 in-house decisions. In-tolerance results withheld rose from **0 to 10** in the latter test.



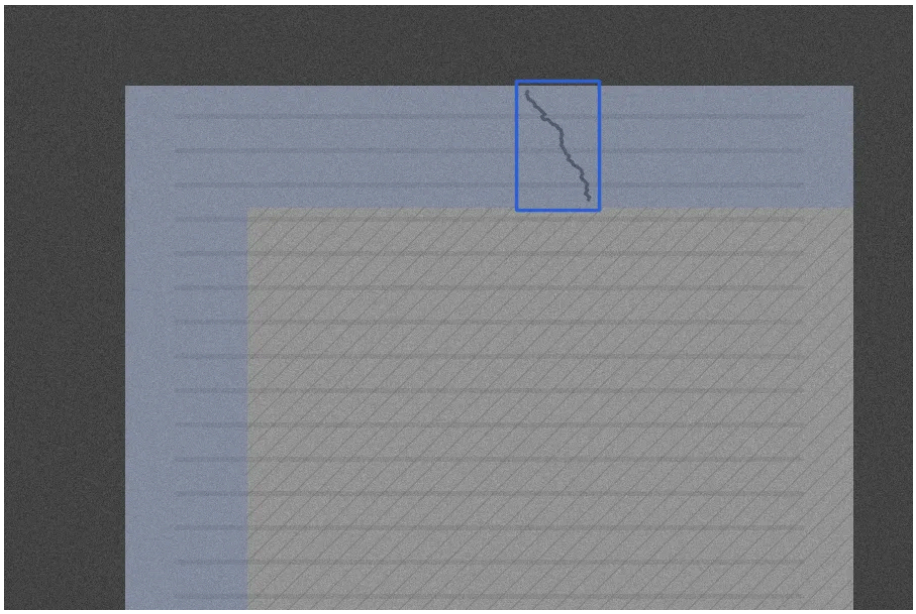
Grid estimated on a synthetic die array (1.8° rotation, column fixed-pattern noise)

Problem	Matching features registered by people cost registration effort for every recipe and still left failures. The first version met the customer criteria over thousands of production runs, but on low-contrast images it sometimes gave a wrong angle a high score.
Implementation	I reproduced the failure on synthetic images and narrowed the cause to the camera's fixed-pattern noise. The method fits a grid to the die-array period and scores consistency across many points, so a wrong answer scores low.
Evaluation	The 11 synthetic scenarios used known input rotations. The in-house test used 16 patterned images, including software rotations, at three region sizes each.
Status	Verified the C++ port in-house. Production qualification is in progress.

Evidence · H1 2026 rotated-material test and September synthetic and in-house decision records

Die-edge crack detection

Of **1,883** detections on the customer sample, **524** were classified as die-edge cracks.



Edge inspection band (blue), excluded region (hatched), and the detected crack (synthetic image)

Problem	The existing die-to-die comparison missed or over-detected edge cracks on stacked memory dies. TB-scale images could not even be opened on a regular PC.
Implementation	Built a standalone program that tiles the image and opens only the needed region, with per-channel saving. Also built a tool that aggregates 7 customer-required align metrics from logs into Excel.
Evaluation	Edge cracks accounted for 27.8% of the detections. The evaluation did not pair both methods' results with ground truth on the same sample, so changes in misses and false calls cannot be calculated.
Status	Verified crack and chipping detection on customer material.

Evidence · May 2026 customer-sample edge-crack evaluation