

Moving towards an automated MLC QA solution

INTRODUCTION

- Accurate MLC QA is critical
- Film, portal imaging (EPID), and log files can be used to assess MLCs
- Multivendor compatibility needed
 - Unified analysis for Elekta & Varian

METHODS

- New in-house analysis tool combining EPID & logfile was developed
- Limitations of film, EPID, and log file analysis were characterized
- Compared Picket Fence leaf and FWHM errors between film (*FilmQA*¹), EPID (*Pylinac*²), and log file
- Evaluated sensitivity to ideal and heavily distorted bands

Limitations

- Placement of light field isocenter on film is subjective and inconsistent
- EPID panel sensitivity varies between machines and models
 - Yields inconsistent border pickets
- Log file data structure, public availability, contents, and standards vary between vendors
 - Requires an intermediate data harmonizing step

RESULTS

	Uncertainty	Total Time	Reproducibility
Film	1-2 mm	30-45 min	Difficult
EPID analysis	0.5 mm	5 min	Panel dependent
EPID + Log file	0.03 mm	5 min	Consistent

Table 1: Summary of key differences for each MLC QA approach.

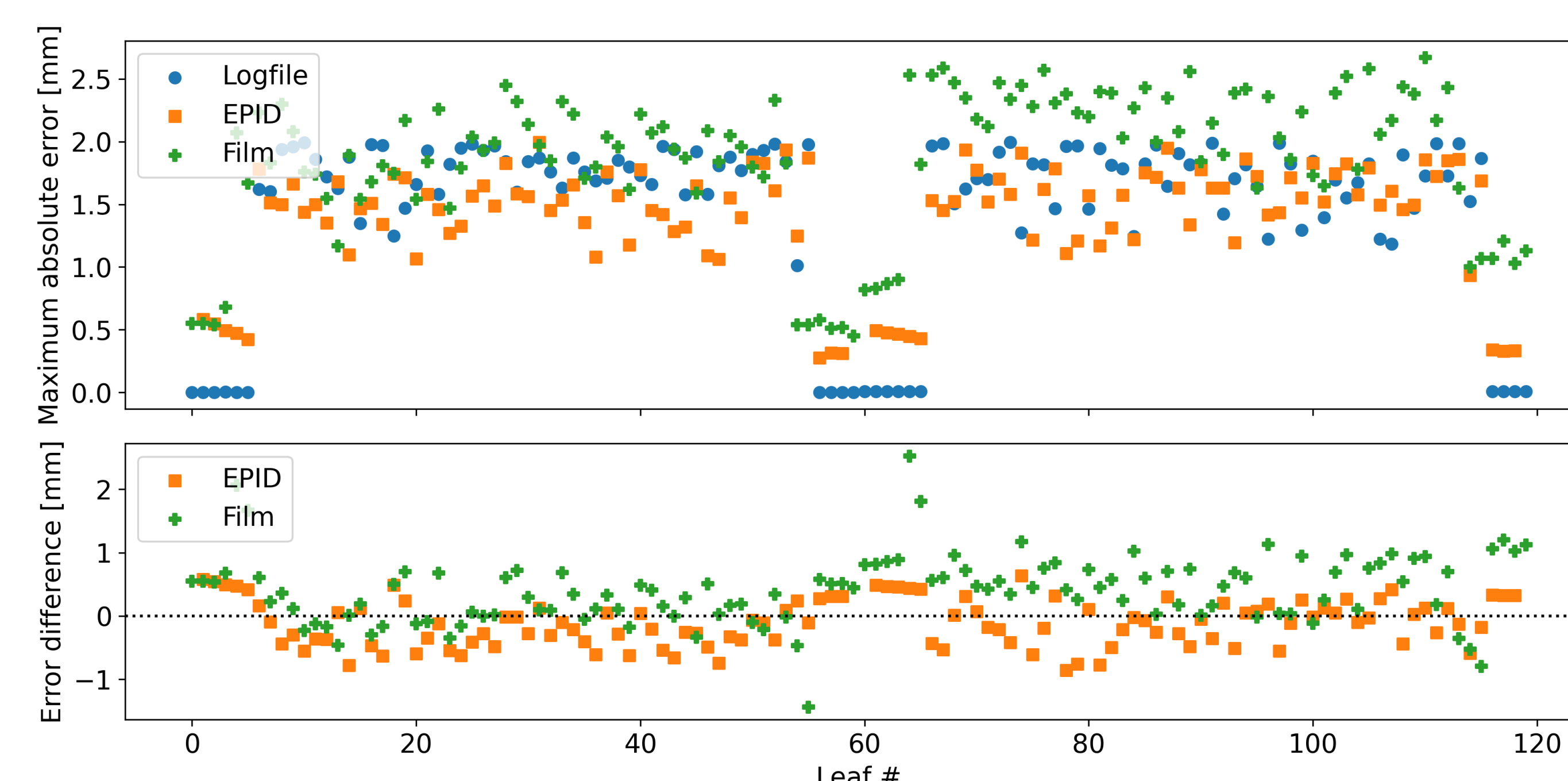


Figure 1: Maximum reported leaf error from planned position for film, EPID, and logfile analysis (top). Error differences relative to logfiles for EPID and film (bottom). Analysis performed using a TrueBeam linac with Millenium 120 MLCs.

- Observed consistent position errors in film and EPID analysis when leaves were in their expected positions according to logfiles
- EPID reported errors are generally slightly smaller than logfile reported errors

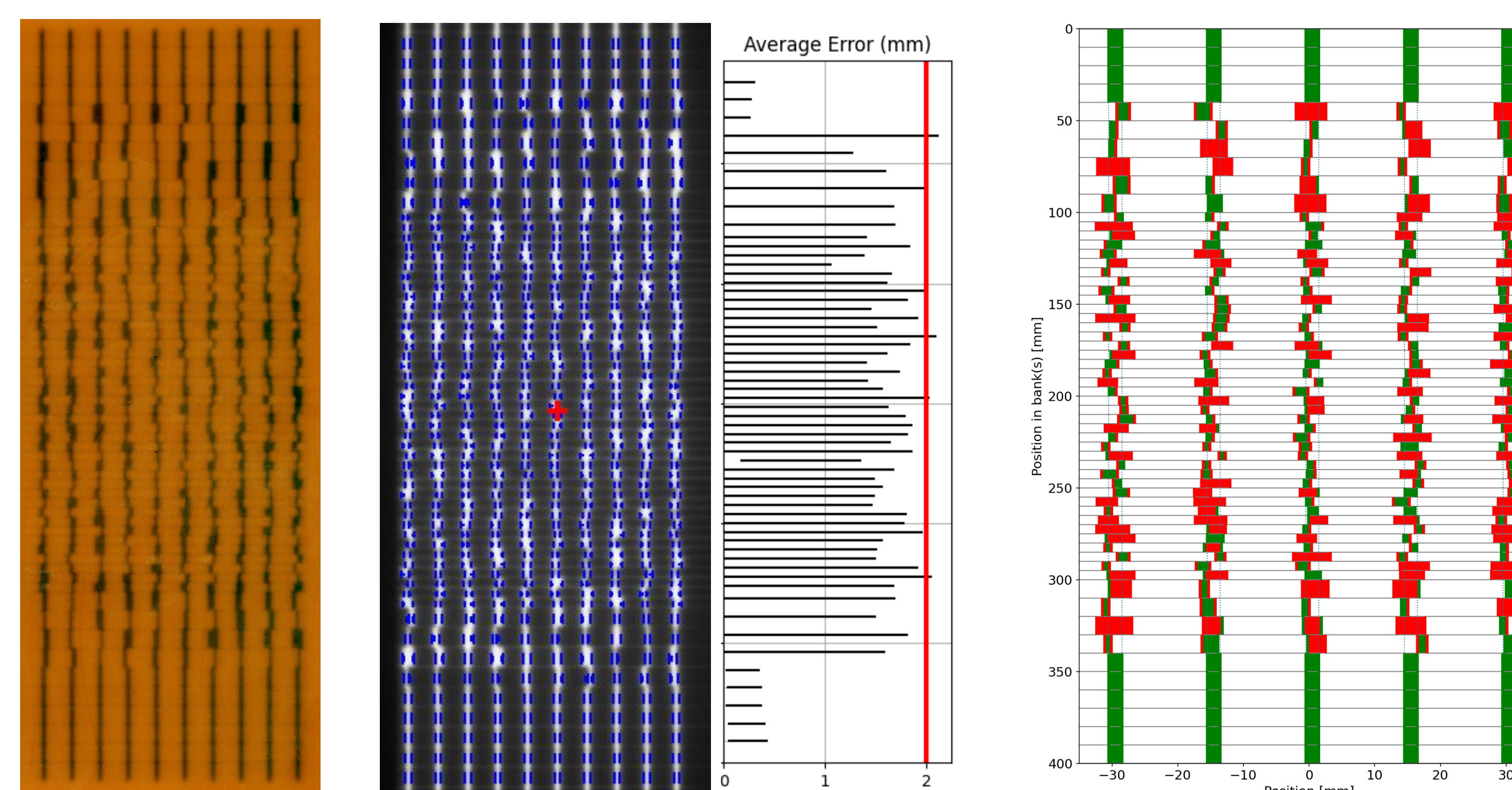


Figure 2: Scanned film (left). Reported average MLC position error for the EPID analysis with Pylinac (middle), and logfile analysis result (right) for same delivery

DISCUSSION

- Logfiles alone are insufficient and may silently fail to detect an MLC positioning error
 - Encoder or programmatic failures
- Passive and simultaneous verification with an EPID acquisition offers a validation of logfiles
- EPID-logfile comparison can be performed during routine QA
- Further study required to establish a baseline to compare methods
- An optimal solution requires a standard protocol across all vendors
 - Difficult due to mechanical and software limitations

CONCLUSIONS

- New in-house software to directly compare film, EPID, and logfile MLC positions
- EPID-logfile MLC QA is performed in minutes with sub-mm precision
- Daily logfile comparison with EPID provides confidence in logfiles
- Provides early framework for the continuous monitoring of MLC performance

References

- 3cognition LLC (2007). *FilmQA* (V. 2.2.0113)
- Kerns, J. R., (2023). Pylinac: Image analysis for routine quality assurance in radiotherapy. *Journal of Open Source Software*, 8(92), 6001, doi: 10.21105/joss.06001