Setting Standards

Customizations for Biological Dosimetry

MetaSystems

METAFER
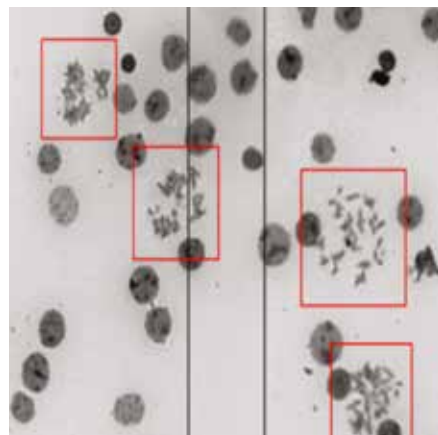# BIODOSIMETRY
AUTOMATION

Managing Swift Responses to Radiation Accidents

Biological dosimetry involves the assessment of biological markers, such as chromosomal aberrations or micronuclei, to estimate the dose received by an individual following radiation exposure. The fundamental principles include the correlation between biological effects and radiation dose, the use of well-established biomarkers, and the application of quantitative models to interpret these effects.

Speed is vital in biodosimetry analysis as prompt results are key for effective medical triage and intervention during radiation emergencies. Quick analysis enables rapid evaluation of exposure levels and supports immediate treatment, and aids in managing resources effectively. Given that many established biodosimetry tests involve microscopy, automating the analysis can be a significant advancement.
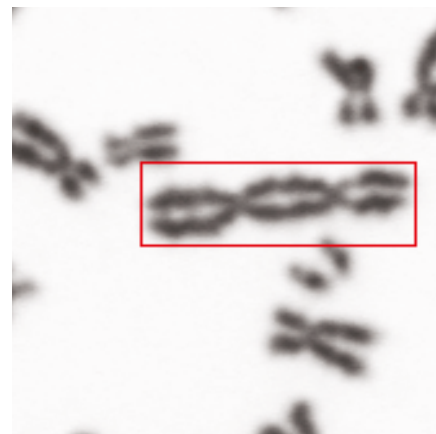

Chromosomal Aberrations

Micronucleus Assay

Facilitating International Collaborations

The standardization of microscopy in international biodosimetry collaboration networks offers significant advantages by fostering uniformity and reliability across diverse research settings. Standardized protocols and calibration methods enable seamless data comparison and integration from different laboratories worldwide, enhancing the accuracy and credibility of collective findings. This uniformity is crucial for developing globally recognized dose-response curves, improving radiation exposure assessments, and facilitating swift, coordinated responses to radiological emergencies. Moreover, it promotes resource sharing, collaborative research, and the development of universally accepted guidelines and regulations, ultimately advancing the field of radiation safety and public health on a global scale.

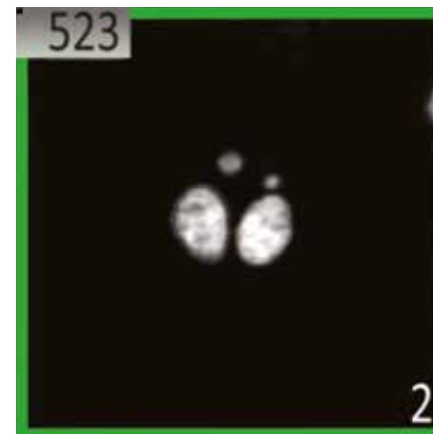*Suitable DNNs have the potential to improve the search for metaphases.*

(i) Artificial Intelligence

MetaSystems can integrate Deep Neural Networks (DNN) into its Customization Packages to enhance various processes like metaphase finding or aberration scoring.
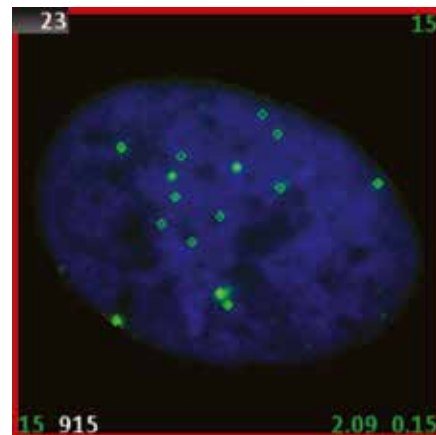
Together with users, MetaSystems continually improves DNN workflows, e.g., to detect aberrations like ring chromosomes and fragments.
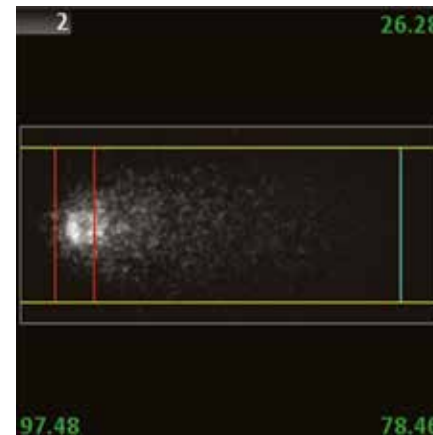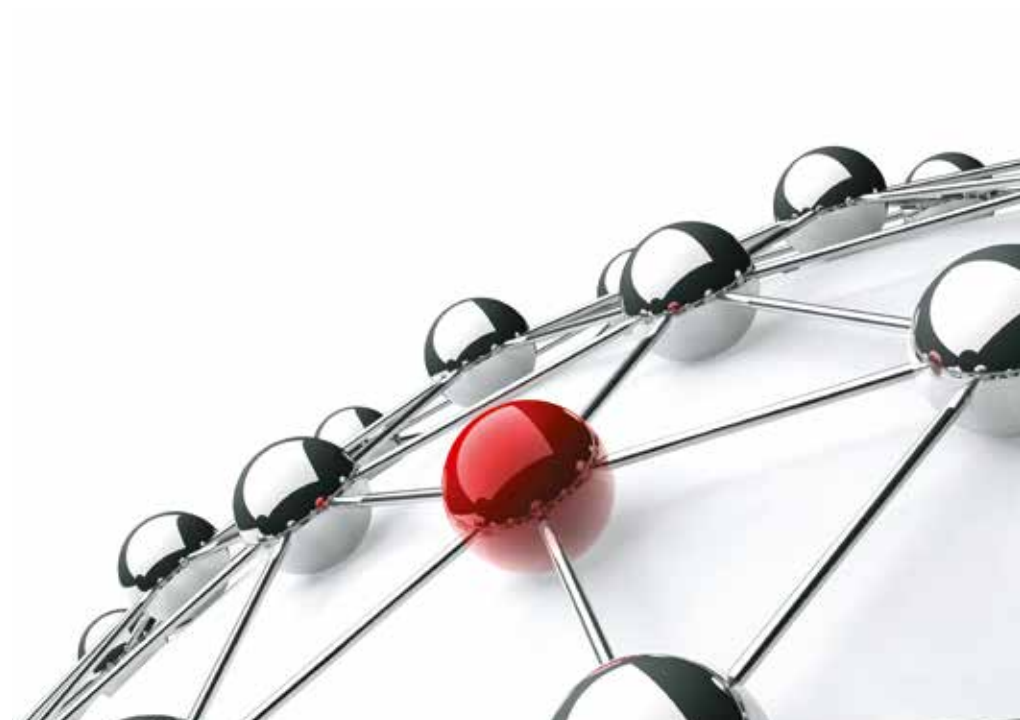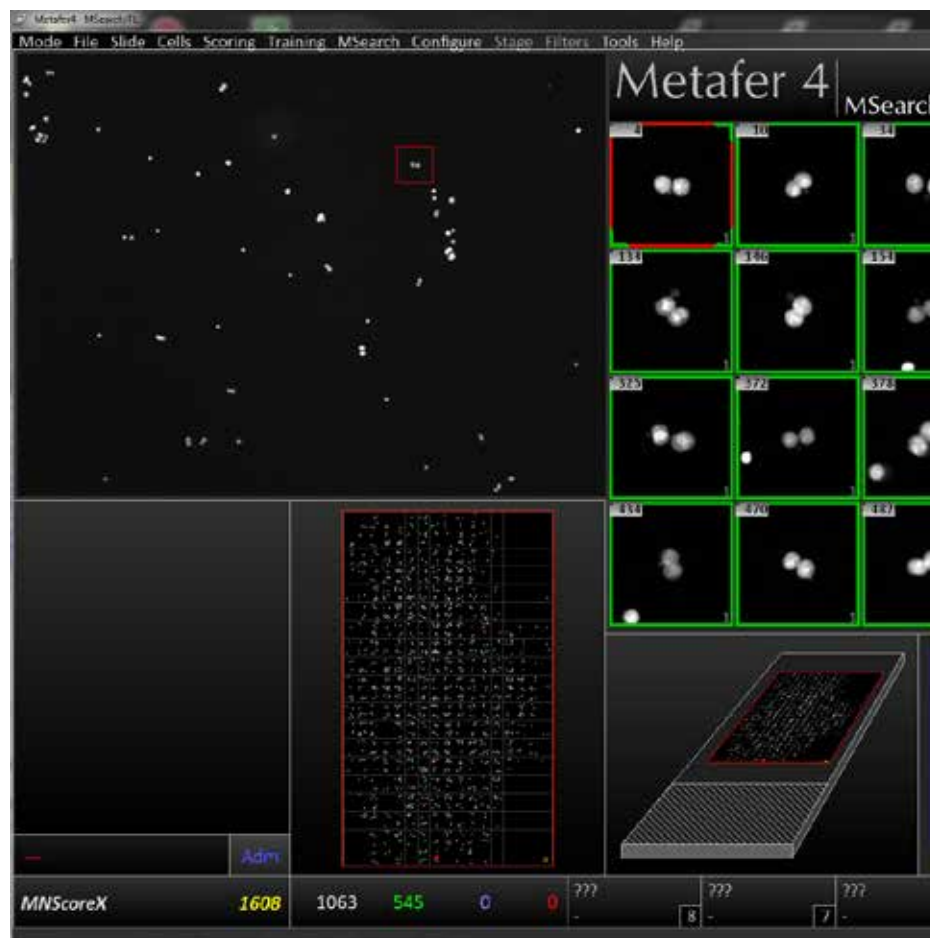

γ-H2AX-Foci

Comet Assay

MetaSystems

THE CHROMOSOMAL ABERRATIONS TEST

Benefits

- **Automated Metaphase Finder:** High-resolution imaging and efficient metaphase identification.
- **Customizable Analysis:** Customizable scoring sheets for on-screen aberration scoring.
- **Collaborative Review:** Offline installations enable work-sharing and collaborative evaluations.

- **Thorough Documentation:** Comprehensive records with full audit trails.
- **High-Volume Capacity:** Capable of scanning up to 800 slides per run with the optional SlideFeeder x80.
- **Automated Detection:** Scoring of dicentric chromosomes with the DCScore customization package.

The Gold Standard

Testing for chromosomal aberrations, while detailed and requiring careful manual analysis, is recognized as the „Gold Standard" for evaluating DNA damage due to its precision.

Metafer simplifies this process, offering a variety of tools that accelerate and standardize analysis. Additionally, all results are thoroughly documented with images and data, ensuring the highest level of traceability.

THE CYTOKINESIS BLOCK MICRONUCLEUS ASSAY

Benefits

- **Effortless Detection:** Automated detection and imaging of bi-nucleated cells.
- **Automated MN Scoring:** Micronuclei are counted in each detected object.
- **Seamless Review:** Intuitive review process with each detected object displayed in a convenient gallery.

- **Quick and Easy Edits:** Swift and effortless adjustments, thanks to the user-friendly review workflow.
- **Comprehensive Reporting:** Generation of detailed summaries, statistics, and results using the integrated report editor.
- **Reproducibility:** Fixed parameter sets allow to standardize the tests.

Proliferation

Measuring cell proliferation, or cell growth in culture, can provide valuable insights to aid in interpreting micronucleus results.

The optional Customization Package for assessing the proliferation index (CBPI) assists Metafer users in simplifying and streamlining this process.

ⓘ Recent Publications

Numerous radiation protection networks and other users globally rely on Metafer for biological dosimetry and share the outcomes of their validation and calibration research. On the right you can see some recent examples of these publications; additional studies can be found on our website.

Lee Y., *et al.*: Application of a semi-automated dicentric scoring system in triage and monitoring occupational radiation exposure. *Front Public Health* 10, 2022.

Vral A. *et al.*: RENEB Inter-Laboratory Comparison 2021: The Cytokinesis-Block Micronucleus Assay. *Radiat Res* 1, 2023.

López JS., *et al.*: Establishment and validation of surface model for biodosimetry based on γ-H2AX foci detection. *Int J Radiat Biol* 98(1), 2021.

Schuermann *et al.*: Assessment of Genotoxicity in Human Cells Exposed to Modulated Electromagnetic Fields of Wireless Communication Devices. *Genes* 11(4), 2020.
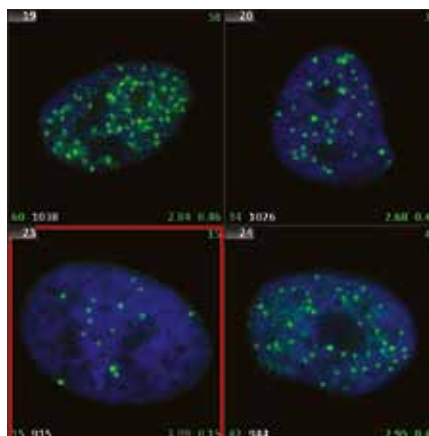
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THE γ-H2AX FOCI ASSAY

Benefits

- **Automated Nucleus Selection:** Identifies nuclei based on morphology criteria defined by the user.
- **Enhanced Signal Aquisition:** Captures signal channels as focus stacks for more detailed analysis.

- **Comprehensive Display:** Gallery images present extended focus views, with highlighted nucleus contours and signal positions.
- **Foci Counting:** Signals are counted in consideration of their size.

- **User-definable Thresholds:** Users can set intensity and size thresholds within the classifier.
- **Reproducibility:** Standardized tests are ensured by using fixed parameter sets.

ⓘ Signal Co-localization

Incorporating a second marker can enhance the insights gained from a foci analysis. With Metafer's extensive toolkit for object feature analysis, adding a second color channel to a scan is simple.

Results can then be categorized into different foci classes, showing the presence of either one or both signals for each position.

THE SINGLE CELL GEL ELECTROPHORESIS (COMET) ASSAY

Benefits

- **Unattended Object Selection:** Automatically detects cells with customizable parameters.
- **Automated Thresholding:** Reliably identifies head and tail positions with consistent accuracy.

- **Results Assessment:** Displays proposals for a wide range of parameters, e.g. Tail Moment, Tail Moment Olive, %DNA in Tail, and many more.
- **„Hedgehog" Comets:** Identifies highly damaged cells (option).

- **Gating of Populations:** Cell populations can be selected based on the data presented in the results graph.
- **Reporting:** Results are summarized in customizable reports.

ⓘ High Throughput Comet Assay

Metafer supports both standard slide samples and slides prepared for the High Throughput (HT) Comet Assay.

This allows for the analysis of up to 96 gels within a single sample. The results for each gel can be stored individually and reviewed through either detailed reports or the comprehensive statistics module.
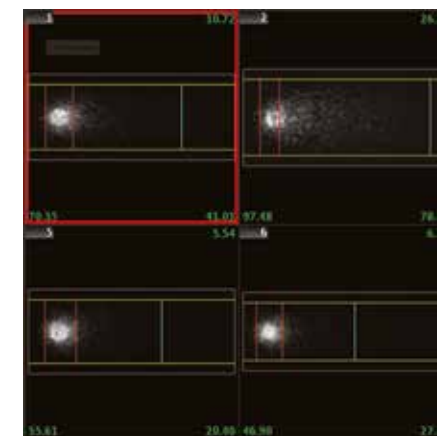

Metafer installation prepared for the scoring of micronuclei. The software integrates with a motorized microscope, supports up to two ultra-high resolution digital cameras (CoolCube 4 or CoolCube 4P), and includes a robotic slide frame exchanger (SlideFeeder x80) capable of handling up to 800 slides per run. ▶

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MetaSystems offers **Customization Packages** for application workflows that have been successfully implemented for customer labs using standard Metafer platform functionality. It is expected that they can be implemented for other customer labs using similar workflows and slide preparation procedures. If a Customization Package is purchased, MetaSystems product specialists will - based on their experience from other similar application cases - support the customer lab in adapting the Metafer software configuration to their needs. The performance of the solution will depend on the quality of the customer slides and the expertise of the users, MetaSystems cannot specify or guarantee any performance parameters. The validation of the solution for clinical use is the sole responsibility of the customer lab.

MetaSystems software provides, among other functions, features to assist users with image processing. These include, but are not limited to, the use of machine and deep learning algorithms for pattern recognition. The output generated in this process should be regarded as preliminary suggestions and, in any case, mandatorily requires review and assessment by trained experts.

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