Ikaros/Isis

Discover Scalable and Innovative Solutions for Karyotyping and FISH
INNOVA

INTELLIGENT WORKFLOW

AI and Karyotyping

Chromosome analysis is a routine method of cytogenetics and has been considered the “gold standard” in genetic diagnostics for decades. Until today, the generation of a karyogram has remained a highly interactive procedure.

Mesmerizing developments in the field of Artificial Intelligence (AI) have opened up entirely new horizons for image analysis in recent years. In the latest versions of Ikaros, MetaSystems has implemented algorithms based on Deep Neural Networks (DNN). DNN use self-learning algorithms for pattern recognition in images.

The new Ikaros supports automatic separation of chromosomes and overlaps, as well as intelligent assignment of chromosomes to karyogram classes. Ikaros is able to generate karyogram proposals with an unprecedented high probability of accurate chromosome assignment, thus, simplifying the task for the reviewing expert.

Our lab had the opportunity to be the first user to test the beta-version of MetaSystems’ new AI-based karyotyping software Ikaros. We experienced a time gain of up to 50% in the karyotype analysis of bone marrow metaphases. This enormous gain in efficiency allows us to keep pace with the ever-increasing workload in times of shortage of personnel resources.

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A karyogram proposal is created and made available for all connected workstations. Icons indicate assignment probability by colors.

Artifacts and chromosomes of neighboring metaphases are excluded using a specialized algorithm.

All rejected chromosomes and/or artifacts remain accessible for review and correction, if necessary.

* If the automated imaging of slides is not demanded, the user manually captures microscopy images with Ikaros (see our Modules Overview on the last two pages).
IKAROS

Quality
Images can be acquired at the microscope with Ikaros or automated with the Metafer Metaphase Finder. In both cases, the quality of the captured images is excellent due to the sophisticated combination of high-resolution digital cameras with a variety of special software features. The latter include automatic contrast adjustment, intelligent focusing aids, and a comprehensive banding enhancement filter that is simply applied with the mouse.

Ease of Use
The clear design of the user interface enables fast and fatigue-free analysis. Working with Ikaros is extremely easy, and therefore, training times can be reduced to an absolute minimum. Generally, it takes only a few minutes until a user’s first karyogram is prepared, and the skills required to operate the tools in Ikaros can be easily shared among colleagues and new members of the laboratory.

Speed
Time and accuracy are of the essence in routine cytogenetics. Ikaros was developed to enable extremely fast processing of metaphases. To achieve this goal, we established a remarkably lean software architecture and added artificial intelligence for chromosome separation and assignment. Ikaros thus provides direct and hassle-free access to all required functions with minimal user interaction.

Productivity
With Ikaros, the user can switch between different band types, brightfield and fluorescence illuminations. Furthermore, in addition to karyotyping, various methods in the cytogenetic field can be processed, such as chromosome FISH, mFISH, mBAND and interphase FISH. Since all necessary settings for the respective method are combined in so-called “Experiment Types”, switching between methods is possible at any time with a mouse click.
Karyotyping

One-click image acquisition of G-, R-, Q-, and DAPI-banded metaphases, or of metaphases with other staining patterns
- Focusing aid for automated best focus acquisition
- Zoomable live image display on screen
- Automatic contrast adjustment
- Automatic integration time adjustment in fluorescence mode
- Additional captures to encompass all chromosomes of widely spread metaphases in one karyogram

Image Enhancement
- Automated or manual background reduction and object threshold setting
- Powerful image filter tools for banding enhancement
- Unlimited undo, processing steps list, and any-time access to original image
- Regional thresholding
- High flexibility due to adaptable parameter sets (Experiment Types)

Highlights

Manual Image Acquisition
- Deep Learning (AI, Artificial Intelligence)-assisted assignment of chromosomes
- Separation of chromosome clusters with the chromosome brush tool
- Image zoom function on the mouse wheel
- Check Objects-function to identify clusters

Chromosome Separation
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- Image zoom function on the mouse wheel
- Check Objects-function to identify clusters

Karyotyping
- Deep Learning (AI, Artificial Intelligence)-assisted assignment of chromosomes
- Shifting, swapping, rotating, mirroring and exchanging chromosomes with the mouse in the karyogram view
- Manual and semi-automatic count function and classification of chromosomes in the metaphase
- Idiograms (ISCN 2016) with different resolutions, flexible annotation function, and karyogram form editor
- Karyogram comparison and partial karyograms with aberrant chromosomes

Colored icons indicate the assignment probability.
**KARYOGRAM**

In Ikaros, the workspace is the central part of the screen. The smaller preview images on the right can be configured to show the original image, the false color image or other content. Switching between karyogram and metaphase image is possible at any time in the workflow.

**BUTTON BAR**

The central, configurable button bar allows quick access to all required functions. The buttons are arranged to reflect the usual workflow in karyotyping. Within each function, many subfunctions are immediately available without having to navigate through other menus.

**IMAGE DATA**

Image-related data fields are displayed directly below the work area. Here, information such as the image number and coordinates can be viewed at a glance. The user can enter the image-related karyotype and comments, but also assign the culture or slide designation.
Below the icons under the main button bar is the area where the current user and experiment type are displayed. The icons above allow easy access to less frequently used functions, including the settings where experiment type specific adjustments can also be made.
Productivity
Sometimes it is necessary to detect and identify very fine structural changes in chromosomes. With the multicolor FISH (mFISH) module, Ikaros helps the user to obtain precise information about the origin of each chromosome fragment, even the smallest, by evaluating the color channel intensities pixel by pixel. With the multi-color banding (mBAND) evaluation, this even works for intra-chromosomal rearrangements.

Ease of Use
Both in karyotyping mode and in color image mode, users have access to the same highly convenient user interface. This means that the same processes, links and functions are available at the same place. In the case of color image processing, these are supplemented by specific functions for fluorescence image processing. So if you are familiar with karyograms, you will need little to learn to evaluate fluorescence images. This also applies vice versa, of course.

Quality
It is not uncommon for fluorescence images to show a high background, artifacts, or weak signals. For Ikaros users, however, this is no reason to reject the image. With just a few clicks, the grayscale thresholds in each image can be adjusted. This is possible separately for each of the color channels and even for individual areas within the image. The original image is retained in Ikaros, so that changes can also be selectively undone at any time.

Speed
In fluorescence microscopy, several repetitive steps are often required to prepare each image for analysis. Ikaros’ color mode provides ultra-fast tools for this, some of which can be applied with just one mouse click or keystroke. This enables an extremely fast workflow, allowing the user to focus on the important part of the job: the actual analysis.

FISH IMAGING

Various false color modes facilitate the interpretation of the images.

In fluorescence mode, Ikaros supports up to 12 color channels.

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Highlights

Image Acquisition
- One-click acquisition of fluorescence images with up to 12 color channels
- Support of most motorized microscopes
- Focus stack imaging
- Automatic integration time adjustment separately for each color channel
- Focus offset settings for individual fluorochromes

Image Enhancement
- Automated or manual background reduction and gray level threshold settings
- Quick image enhancement with shortcuts
- Separate enhancement of each individual color channel
- Regional thresholding
- High flexibility due to adaptable parameter sets (Experiment Types)
- Fluorochrome profile measurement
- Flexible annotation functionality

Color Karyotyping
- Chromosome separation and assignment in either full color, grayscale, or inverted counter stain
- Selective display of color channels in the karyogram
- Idiograms (ISCN 2016) with different resolutions, flexible annotation function, and karyogram form editor
- Karyogram comparison and partial karyograms with aberrant chromosomes

Multicolor FISH
- Analysis of fluorochrome combinations and false color display of chromosomes
- Labelling scheme display in karyograms
- Tooltip identification of chromosomes
- Single-color binary view for quick identification of rearrangements
- Single Color Gallery to identify the origin of chromosomes, chromosome parts and markers
SCALABLE SOLUTIONS

Bespoke Multi-User Networks
The sub-modules of Ikaros support the easy configuration of multi-user environments with separate imaging, analysis, and review stations for de-centralized working. With the solutions of MetaSystems, it is possible to extend the scalable multi-user network at any time and grow with the prospective demand.

Every Ikaros module comes with a sophisticated case and workflow management called Neon. Neon takes care for data security, easy content access, and user management.

For a higher degree of automation, MetaSystems optionally offers the Metafer software for use as a metaphase finder or a FISH imaging device. With Metafer, the generation of karyograms can be completely automated.

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Ikaros DNNServer
Artificial Intelligence
The Ikaros DNNServer is the central computing unit for all DNN-based applications. The software receives images from connected Ikaros instances and applies state-of-the-art artificial intelligence methods to provide an interpretation suggestion.

Workstation Module
Karyotyping/FISH
The workstation software offers all functions for generating karyograms and contains DNN-based algorithms for chromosome assignment and separation. The respective Isis software allows for offline fluorescence image analysis and optionally karyotyping of fluorescence images.
Ikaros/Isis Full Station

Image Acquisition
If used as stand-alone system, this module provides the basic image acquisition functionality. If a Metafer metaphase finder is available, it can take over the image acquisition. Together with Isis, also fluorescence images can be taken.

Neon

Case / Image Management
Neon is part of all Ikaros and Isis installations. It provides the framework for organizing images, cases, data, and workflows. Neon ensures that all contents are well presented and stored securely. Neon also helps creating comprehensive statistics and reports.

Metafer

Metaphase Finder
Optionally, Ikaros users can employ a metaphase finder based on the Metafer software to acquire images fully automatically. Metafer can also support the assessment of fluorescence preparations. Please inquire for details and conditions.

Ikaros/Isis Review

Annotations
The Review Software provides all functions for reviewing Ikaros and Isis images and for editing and annotating images and karyograms on remote workstations. It generates combined karyograms and offers many options helping the expert to make a diagnosis.

Isis Multicolor Software

Fluorescence/FISH
This software supports the user in the evaluation of multicolor FISH (mFISH) or multicolor chromosome banding (mBAND) samples. It supports the use of up to 12 different color channels and allows to display images in multiple false color modes.

Neon Data Software

Case and Data Management
This software is used to enter and manage data and cases. It is ideal, for example, as a central data entry interface for the secretariat, where incoming cases are to be registered in the system for the first time.