MetaSystems

Product Fact Sheet

Ikaros Karyotyping System

Ikaros is the renowned interactive karyotyping system of MetaSystems. With its intuitive user interface Ikaros is designed to minimize the number of interactions from image acquisition to the final hardcopy printout of the karyogram. Customizable command buttons resemble the steps in the workflow, and a clearly arranged interface enables fast and easy working. Editable macro commands replace frequently used commands and speed up the analysis of images.

A topic-orientated online help is implemented in Ikaros. The online help is context-sensitive: help and information that is associated to the current function in Ikaros is automatically displayed.

Ikaros has an integrated patient database, and the MetaClient dashboard facilitate maintaining, filtering, searching and analyzing cases and images from all systems in the network. The flexible report generator enables fast and comprehensive presentation of the analysis results.

As a part of the software package the archiving software MetaArchive tracks all the work and takes care of secure and complete archiving to RDX® archiving media (500 GB storage capacity).

The flexible Ikaros system architecture simplifies adaptation of Ikaros stations to the user's individual working conditions. Ikaros can be easily extended to a multi-user installation, including dedicated workstations for capturing, analysis, and review.

Ikaros can be either installed as stand-alone system, seamlessly integrated into the Isis FISH imaging system, or as a supplement to the Metafer automated slide scanning platform, providing maximum efficiency for laboratories with high workload.

Hardware

Microscope compatibility

Ikaros is compatible with any high quality microscope that is, or can be equipped with a trinocular photo / TV tube.

MetaSystems CoolCube camera

- High resolution 1.3 megapixel USB CCD camera
- 12-bit, 15 fps, 1360x1024 pixels
- 2/3" sensor for wide field-of-view, facilitating capturing of widely spread metaphases in one image

PC

- Compatible Microsoft® Windows PCs, currently using Windows® 7 Professional.
- Hardware regularly upgraded to the state of the art.
- 24" TFT-Monitor

- RDX® archiving drive and media, providing the systems with a long-term data storage possibility according to the regulation for archiving of medical data, as well as high storage capacity of 500 GB.
- AC 100-240V, 50/60 Hz

Image Acquisition and Processing

- Depending on the staining technique, sets of pre-made experiment types with distinctive settings for image acquisition, image processing and classification of chromosomes are part of Ikaros; experiment types for following staining techniques available: G-banding, Q-banding, R-banding, C-banding and fluorescent R-banding, experiment types can be easily customized.
- Adjustable brightness of the live image for easier focusing.
- Automatic or manual live image contrast adjustment with possibility to exclude artifacts from contrast calculation.
- Focusing aid with automatic best-focus acquisition.
- Full support of additional captures of an area larger than a camera field; captured images can be merged into one image.
- Free adjustable zoom from 40% to 500% of the original image size in live image, object separation and many other functions.
- Deletion of any unwanted objects or debris lying outside the region of interest in a single operation ('Mask Metaphase' function).
- Various automated or interactive image processing functions, applicable at any stage of the workflow:
    - Object threshold
    - Lower and upper threshold
    - Background correction, clear background
    - Histogram, histogram equalization
    - Intensities, staining …
- User-defined automatic image processing functions for improving image quality, applicable right after capture.
- Adjustable enhancement filter, optimized for particular application, like improving banding pattern in G- or R-band metaphases.
- Images (metaphases) can be displayed in three different stages of image processing:
    - Original metaphase: 'raw' image as it was captured; unmasked, not filtered, not scaled, and chromosomes not separated; image background is still visible.
    - Pre-processed metaphase: image in an intermediate status before the 1st chromosome was displaced, i. e. prior to overlap separation, copy or move commands; all objects at their original positions.
    - Processed metaphase: image in the most advanced state of image processing including all processing steps.

Chromosome Separation

Separating chromosomes is the essential function within metaphase processing, as a karyogram can only be established if chromosomes appear as individual entities. In Ikaros object contour lines are highlighted in colors. This makes it easy to distinguish between separated and adjacent or overlapping chromosomes. Ikaros offers several modes for chromosome separation: automatic mode, semi-automatic mode and manual mode. Within these modes, various commands for separating chromosomes are available.

- Chromosome contour lines are displayed in color and the thickness of the contour lines can be chosen for easier distinction between separated and non-separated chromosomes. The contour lines are updated continuously during separation;
- Automatic or interactive separation of touching chromosomes with auto-zoom.
- Automatic or interactive separation of overlapping chromosomes.
- Cluster separation by outlining either the contour or object area of chromosomes in the cluster.
- Connecting objects, e.g. to keep satellite regions attached to the chromosomes. Alternatively the chromosome contour can be extended, i.e. to adapt the chromosome (object) area of weakly stained chromosomes.
- Deletion of any unwanted objects or debris within the metaphase.
- Line-up display of objects (chromosomes) for immediate identification and separation of touching / overlapping chromosomes ('Check Objects'-function).
- Automatic chromosome counting with interactive correction.
- Advanced chromosome classification in unsegmented metaphase by semi-automatic chromosome annotation; after classification of more than 40 chromosomes, the resulting karyotype following ISCN nomenclature is displayed and updated accordingly.
- ‘Backward’ classification by copying the chromosome assignment from an existing karyotype to metaphase.
- Extensive annotation functions with full access to all system fonts and colors.

Karyotyping

The assignment of chromosomes to their corresponding karyogram classes can be done by a number of specialized modes. After classification of more than 40 chromosomes in the metaphase, the resulting karyotype is automatically transferred to the karyotype data field below the metaphase image. By changing a classification, the karyotype is updated accordingly. The format of the karyotype follows ISCN nomenclature: total number of chromosomes, sex chromosomes, numerical aberrations.

- Automatic classification based either on banding patterns of about 20 characteristic chromosome features (only human), or based on chromosome size (for all species); pre-made human classifiers for G-, R-, and fluorescent R-bands for human chromosomes associated with corresponding experiment type available.
- Interactive classification.
- User trainable automatic banding classifier.
- Automatic karyotype generation and updating (following ISCN nomenclature).

- Chromosome buffer, which holds all chromosomes (and other objects), that have not been assigned to chromosome classes. The content of the buffer is saved with the karyogram.
- Automatic highlighting of selected chromosome in metaphase during karyotyping and vice versa (supports multiple capture fields).
- Easy chromosome rescaling, rotating, mirroring, shifting, flipping.
- Automatic or interactive chromosome straightening.
- Single or multiple chromosome contrast modification.
- Insertion of idiograms into the corresponding class in the karyogram; support of idiograms from different species, as well as human G-band idiograms with resolutions of 300, 400, 550, 700 or 850 bands and more differentiated shades of grey (according to ISCN 2009), human R-band idiograms, and inverted presentation of human idiograms.
- Translocation analysis by cutting and joining of chromosomes and idiograms in order to build aberrant versions for comparison with observed abnormality; chromosomes or idiograms can be cut several times; sections can be deleted or rotated; idiograms can also be colorized to make them distinguishable.
- Numerous karyogram forms for humans, for animals and plants; modification and creating new karyogram forms possible with the integrated karyogram form editor.
- Extensive annotation functions with full access to all system fonts and colors.
- Export function of metaphases, karyograms or single chromosomes.

Analysis

- Comparison and review of karyograms from different cases class-by-class, or within a case, or among cases; chromosomes can be reviewed in the context of the original or the processed metaphase.
- Display of chromosome lengths in a karyogram: data are shown as table with chromosome class number, chromosome lengths in pixels, chromosome lengths in µm (µm), and p-arm to q-arm ratio (p:q).
- 'View Image' function providing a palette of tools to combine different images or selected image parts for analysis or presentation purposes; image fields, particular region of interest, or chromosomes from a karyogram can be copied into a view image; view images can be resized, rotated, freely arranged on the screen, combined, exported or saved as separate image.
- Second scaleable review window showing the karyogram in the metaphase view or the metaphase in the karyogram view; reopens automatically on the following program start; chromosomes selected in the karyogram are indicated by contour lines on the review window; a chromosome in the karyogram can be selected by a mouse click on the metaphase shown in the review window.
- Insertion of descriptive text (annotations) directly into the image; arrowheads, arrows and lines can be used to highlight remarkable observations; user-definable templates facilitate the creation of text annotations.

Patient Database and Archiving

- Comprehensive, customizable patient management system:
  - Searchable fields allow fast navigation and data retrieval.
  - Flexible automatic data in- and export and data exchange with external patient management systems.
- Convenient and safe procedure for daily incremental archiving of patient data and images, as well as of third party files, to any external media, hard disc or (network) drive with MetaArchive software:
  - All new and modified files are automatically identified and archived.
  - Already archived files are excluded from backup.
  - Original directory structure is replicated on the archiving media, making it easy to locate any archived case.
  - By default, data are archived on RDX® media, providing a storage capacity of 500 GB and long-term data storage according to the regulation for archiving medical data.

Data Managing / Searching / Reporting

Every Ikaros installation is equipped with MetaClient, a comprehensive user interface for maintaining, filtering, searching and analyzing cases and images from all systems in the network. MetaClient is connected to MetaServer, a software that does the background indexing of all data created by any Ikaros system.

- Automatic collecting, sorting, and displaying of data generated by all Ikaros workstations within a network or on a stand alone system.
- Multiple data retrieval and search possibilities of even complex patient databases.
- Integrated report editor enabling the users to create own print templates, that can include images, text, and the content of any case or image data field; all reports can be easily printed, exported as PDF file, Microsoft® Word or XML file.
- Association of many common external formats with a case (PDF, DOC, JPG, BMP, TIF…) supporting a paper-free laboratory.

Further details are provided in the document ‘MetaClient / MetaServer Product Fact Sheet’.

User Management / Safety Concept / Error Handling

- Multi-level management of user access rights.
- Password protected user login.
- Error-safe storage of original image together with a complete list of all processing steps (including date, user name, and timestamp) for every modification; unlimited verification and correction of steps.
- In the unlikely case of a software failure the integrated Exception Reporting Tool automatically compiles relevant information on the actual program situation and the configuration parameters in a standardized set of data (Exception Report); exception reports

can be either automatically uploaded to the MetaSystems' dedicated server site or sent by Email.

Configuration / Upgrades

- Program configuration management allows user specific and staining specific configurations and a global configuration in networked systems.
- Multiple images from the same case can be cooperatively processed at the same time from different workstations, thus greatly enhancing efficiency.
- Integration of Ikaros with the automatic slide scanning system Metafer provides the ideal solution for laboratories with a high work load.
- Built-in networking capability enables flexible multi-user environments combining full workstations with capture only systems, analysis systems, or review workstations.
- Image files contain all relevant parameter values for the particular application (e.g. processing steps, capture settings, or user information), allowing easy exchange between systems.

Further details are provided in the document 'Ikaros and Isis Product Family Overview'.