Intelligent Forensic Sperm Detection
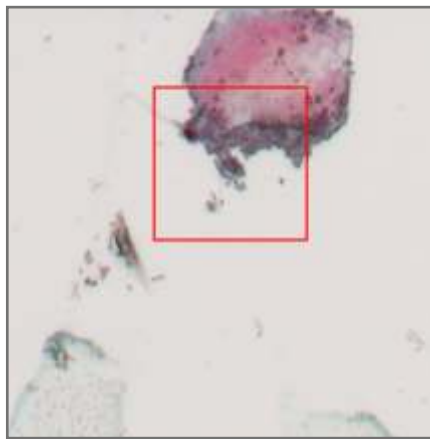
Metafer
SpermFinder DNN
Application Package

MetaSystems

METAFER SPERMFINDER DNN
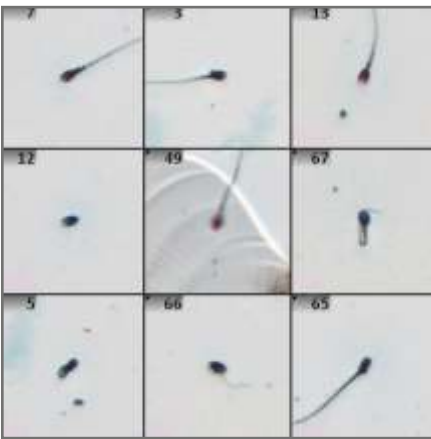
Sperm cell detection is a widely used forensic analytical tool in the investigation of sexual offenses. However, manual detection of sperm cells in a sample is a tedious and complex task. The method is moreover very time-consuming and difficult to standardize.

As a result, many forensic laboratories worldwide report a backlog of cases that cannot be processed in a timely manner.

Automated sperm detection is therefore one of the most efficient methods to quickly determine the presence of spermatozoa. Valuable evidence is immediately evaluated, assessed, and documented. MetaSystems has developed a new Deep Neural Network (DNN) based algorithm trained with thousands of pre-classified data, bringing the benefits of artificial intelligence to the field of automated sperm detection. Using the DNN algorithm, the well-known scanning software Metafer can detect even cryptic sperm cells.

Image Left: Gallery of detected spermatozoa in Metafer SpermFinder DNN.
Image Right: Cryptic sperm cell detected by Metafer SpermFinder DNN.

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HIGHLIGHTS AND BENEFITS

Automated Sperm Detection in Forensic Samples with Artificial Intelligence

Metafer SpermFinder DNN uses artificial intelligence to identify semen in forensic samples. The algorithm finds sperm cells even if they are degraded, hidden under other material, or lacking their tails. A complete search on a standard specimen can be done in less than 15 minutes. Metafer supports unattended searches on up to 800 slides, sample prioritization, and bar code reading.

Support of Christmas Tree or Baecchi Staining and Fluorescent Markers

The algorithms of Metafer SpermFinder DNN have been trained with thousands of preparations and support the most commonly used staining methods. Metafer SpermFinder DNN works equally well with specimens stained with Nuclear Fast Red/PIC (Christmas Tree Staining) and with Acid Fuchsin/Methylene Blue (Baecchi Staining). Another algorithm recognizes sperm cells with fluorescent markers.

Full GLP Compliance, Comprehensive Documentation, and High Data Security

Knowing the sensitivity of forensic examinations, Metafer SpermFinder DNN treats all data with the utmost care. Neon, the technology for case and data management integrated in every Metafer installation, is designed to provide full traceability of all processing steps. It also has multi-level user accounts, workflow management, and protection against unauthorized changes to settings and data.

Easy Reviewing, Swift Relocation, and Coordinate Transfer

Metafer SpermFinder DNN generates a gallery image of each sperm cell along with its quality score. This can be used as the basis of gallery sorting during review. Behind each gallery image the exact coordinate on the slide is stored. With a mouse click, the sperm cells can be retrieved under the microscope, and the coordinates can be transferred as a whole to external microdissection systems.

MAGAZINES

Metafer supports the SlideFeeder x80 slide frame changer. Its magazines hold 16 frames with 5 slides each (80 slides in total). A fully equipped device hosts 10 magazines plus one bar code reader. Each magazine is portable and can easily be taken to the workbench for loading.

FEEDER MODULE

The rotating module of the SlideFeeder x80 delivers the slide frames to the motorized stage supported by Metafer.

The device runs unattended and is prepared for 24/7 operation - including intelligent priority sample handling.

AUTOOILER

If the current workflow requires the use of an immersion oil objective, the automated oil dispensing device is engaged.

Detailed sample dependent macros control optimal oil dispersal for each sample.

CoolCube 4

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CAMERAS

The CoolCube 4 cameras recommended by MetaSystems are designed with excellent imaging and automation in mind.

The cameras provide seamless automated integration with Metafer software enabling optimal performance.

MICROSCOPE

High precision research grade fully motorized microscope equipped with a stepping motor stage enables found objects to be precisely recorded and relocated.

- **Objective:** 20x
- **Light:** TL or FL
- **Focus:** Intelligent Autofocus

SOFTWARE

The PC-based Metafer SCAN software controls the respective hardware and provides a comfortable user interface for daily routine use. The application package SpermFinder DNN for Metafer provides the specific functions for forensic sperm detection.
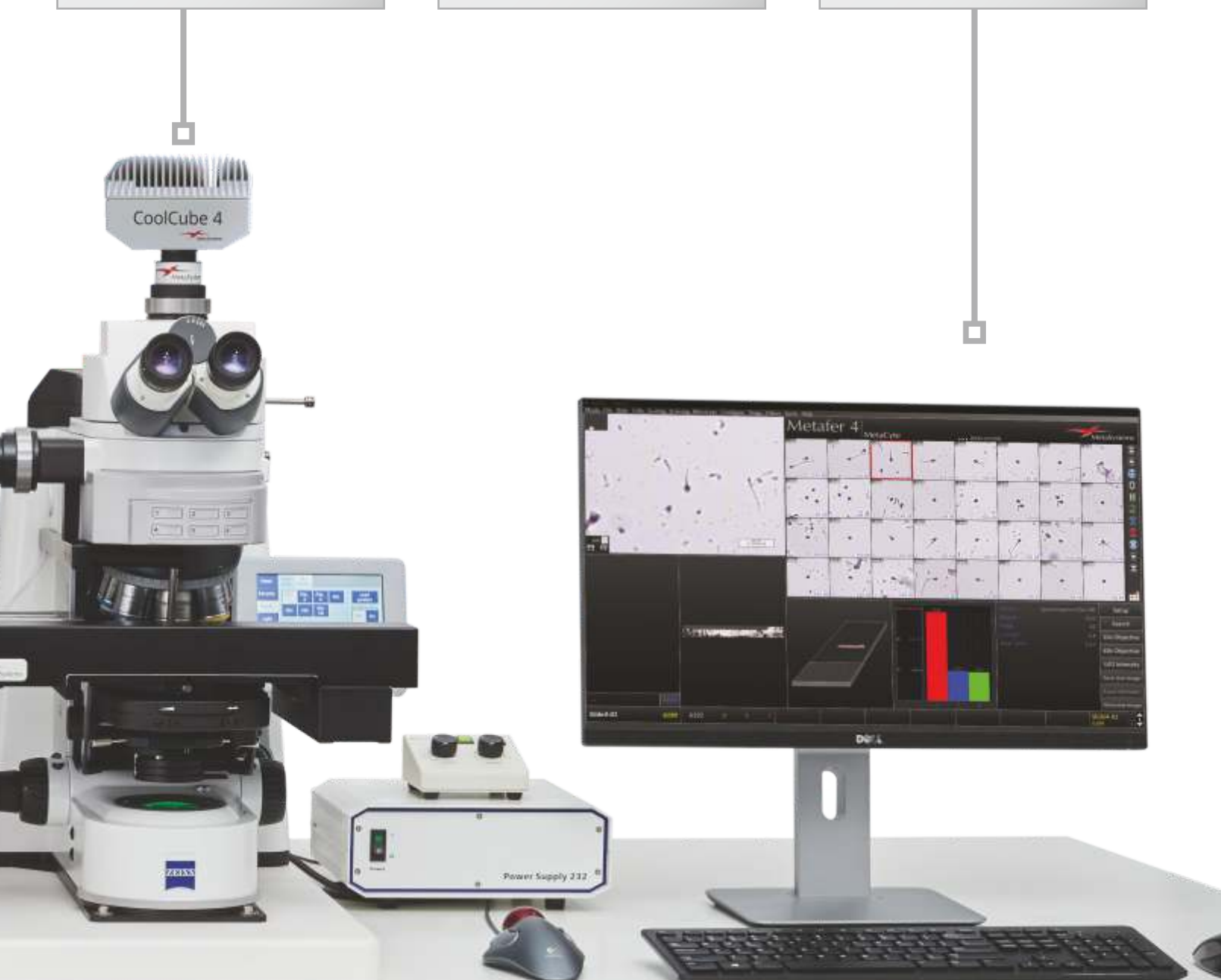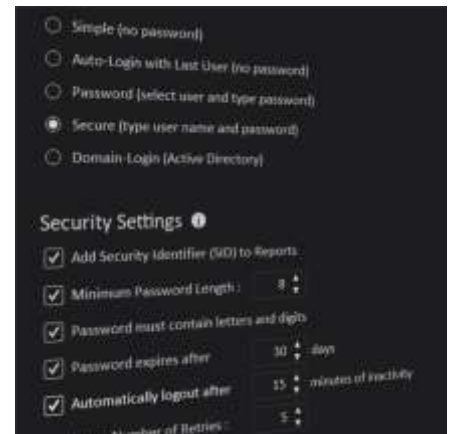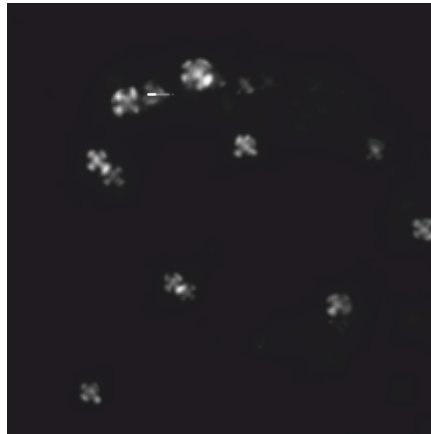
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Image Left: Starch granules are indicators of condom use. In polarized light, they can be automatically detected.
Image Right: Neon's security settings allow the Metafer SpermFinder DNN to be completely and reliably protected against unauthorized access.

Scalability

Systems operated with the Metafer SpermFinder DNN can be configured to meet the requirements of laboratories of different sizes. Different add-ons are available for small, medium, and large laboratories.

If capacity requires 24/7 microscopy operation with the ability to prioritize urgent slides, we can provide an automated slide loader to feed the microscope. This allows for unattended slide scanning overnight or on weekends. With a scalable capacity from 8 up to 800 slides being automatically scanned, we support our customers in high-throughput applications.

Documentation

Manual microscopy allows only very limited documentation of the respective results. With a fully automated imaging system controlled by the Metafer Spermfinder DNN, this is no longer a problem.

Forensic results are sensitive data that, under certain circumstances, should also stand up in court. A fully comprehensive documentation of all images taken, all processing steps, and all results provides the security of being able to prove one's own findings at any time.

Another advantage that should not be underestimated is the possibility of the dual control principle. If all data is available in digital form at all times, it is always possible to obtain a second opinion from another expert in cases of doubt. For this, the expert does not even have to be on site: Metafer offers many possibilities to make data available also via the network - absolutely safe from access by unauthorized persons.

Versatility

The Metafer product family is designed as a modular system, which means that different application packages can be used with the same instrumentation. For example, it is possible to use the exact installation for the detection of starch granules in polarized light or for the digitization and documentation of tissue sections and other specimens.

All findings are clearly summarized by the Neon management technology under a single header (e.g., a case number) and kept available to authorized users at all times. Secure and customizable data administration allows additional content to be added, digital documents to be attached, and findings to be summarized in customized and digitally signed reports.

Larger labs can out-source case review and results editing to separate workstations, with Neon taking care of the data security across the network.

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The described functions refer to the following software version: **Metafer** 4.3

CE IVD   MetaSystems software and system products are classified as in vitro diagnostic medical devices (IVD) in the European Union in accordance with the Regulation (EU) 2017/746 or Directive 98/79/EC, respectively, and carry the CE label unless otherwise indicated. Use all MetaSystems IVD products only within the scope of their intended purpose.

MetaSystems products are used in many countries worldwide. Depending on the regulations of the respective country or region, some products may not be used for clinical diagnostics.

Some hardware components supplied by other manufacturers are not included in MetaSystems IVD products and are therefore not IVD medical devices.

SpermFinder DNN is an application-specific adaptation of the Metafer software. It is possible that further adaptations to specific specimen conditions are necessary.

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