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neuro I mate® - key features

About *neuromate*®

- The first certified image-guided neurosurgical robot to be used in the world
- Designed specifically for neurosurgery and can be used for neuro-endoscopy, stereoencephalography (SEEG), deep brain stimulation (DBS), biopsy and several other applications
- Estimated at over $30 million R&D investment to date[1]
- Renishaw is a world leader in precision engineering
- Installed systems in several countries worldwide

Surgical applications

- Stereotactic neurosurgery procedures
  - DBS
  - Biopsy
  - Implantation of depth electrodes for epilepsy monitoring (SEEG)
  - Motor cortex stimulation (MCS)
- Neuroendoscopy

And many other research applications

System benefits

- Complete procedure solution
  - Procedure specific modules / tools
  - Comprehensive surgical planning / navigation system
  - C-arm, O-arm & X-ray interfaces
  - 2D - 3D registration
  - Frameless & frame-based support (all standard frames)
- Time saving in multiple trajectories
- Compact, easy to transport and easy to clean
- Designed for quick parts replacement
- Quick to set up and operate
- On-board system diagnostics
- Customisable
  - Dimensions
  - Frame adaptors
  - Imaging modalities
  - Powered tool holders for standard or custom tools
- Strong international clinical support team

Safety features

- The *neuromate*® robot has been used for over 20 years in the clinical field for an estimated 10,000 procedures[2]
- Anti-collision system
- Constant accuracy checking with redundant encoders
- Safety line constantly monitoring the status of mechanical and electrical components
- Remote control with safety trigger
- Non-backdrivable joints with no backlash ensure immediate, stiff mechanical locking in case of error condition or power outage
- Full image guidance during planning and operation

As a replacement for the targeting arc of a stereotactic frame or for a tracking system, *neuromate*® offers the following safety benefits:

- Regular calibration ensures system remains within accuracy specifications
- Reduced risk of invisible mechanical damage or wear (compared to a stereotactic frame arc)
- No need for error-prone writing down or setting of target co-ordinates
- Stable mechanical attachment (compared to a stereotactic frame or clamping systems used with a navigation system)
- Stiff tool holding

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Planning and navigation software

(IVS Technology VoXim®/neuromate®)

General features

- Medical image analysis software
- Neurosurgical planning software
  - For stereotactic frame
  - For *neuromate*® system
- Neurosurgical execution and navigation software
  - For *neuromate*® system

DICOM import

- DICOM import
- Data import from DICOM files
- CT and MRI data supported
- CT gantry tilt supported

X-ray import

- Import of image files
- Direct scanner acquisition
- Co-registration
  - With localizer plates
  - With anatomical landmarks
- 2D / 3D / 3D fusion display supported

Patient database

- All data stored in the local file system
- Multiple independent databases can be defined
- Data can be archived, exported, imported, backed up to a CD, restored
- All actions are instantly and automatically saved

Analysis tools

- Zoom
- Move and turn
- Change gray scale
- Localize coordinates of points
- Measure 2D / 3D distances, angles, areas, volumes and bone density

3D reconstruction

- Support of segmentation thresholds
- 3D cut viewing modes

Segmentation

- Manually definable volume segmentations
- Customizable display of multiple segmentations across fused data sets
- Computation of segmentation volume

Co-registration and fusion

- Co-registration modalities:
  - Frame registration (using frame localizer)
  - Device coordinates (identical imaging device and patient position)
  - Automatic matching (mutual information algorithm)
  - Point matching (user-defined anatomical or fiducial point matching)
  - Scaling

Atlas co-registration

- Supported atlases:
  - Schaltenband-Wahren
  - Talairach-Tournoux atlas and connection map
- Co-registration modalities:
  - Talairach transform
  - User-defined point matching

Trajectory definition

- Can be defined anatomically or with statistical (AC/PC) coordinates
- Definition of AC/PC
- Definition of mid-plane: essential for targeting accuracy
  - Patient may be tilted or rotated
- Realignment of all views according to AC/PC line/mid-plane

Endoscopic trajectories

- Definition of safety volumes for endoscopic trajectories including tool insertion position
- Endoscope motion using remote control
- Full navigation capability with tool position display
- Modification of safety volume possible

Surgeon eye view

- Reconstructed planes parallel and perpendicular to the trajectory at various depths
- Dynamically updated view during execution (navigation capability)

Frame-based registration

- All standard frames
- 6 markers in at least 2 slices should be identifiable
- Automatic or manual marker identification supported
- Frame may be tilted

Printing a surgical plan

- Comprehensive multi-page surgical plan comprising surgical coordinates and frame coordinates
- Multiple frame configurations (e.g. reversed bow)

Frameless registration

- Marker search
- Robot control and frameless registration
- Definition of a safety region for robot arm motion

Verification trajectory

- Definition and execution of a trajectory pointing to a visible anatomic landmark, to verify the patient registration

Execution

- Full navigation capability with tool position display

References

[1] Renishaw internal data
[2] Renishaw field service data