Imaging and 3D Holograms to Guide Vascular Interventions

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Disclosure Statement of Financial Interest

Speaker's name: Elchanan Bruckheimer
Within the past 12 months, I or my spouse/partner have had a financial interest/arrangement or affiliation with the organization(s) listed below:

Affiliation/Financial Relationship Company
Medical Director RealView Imaging Ltd.

Interactive Live Holography - Unique Experience

The only true 3D interactive holograms within hands reach
- Ultimate 3D visualization: see real-time true volumes floating in the air
- Close-range precise interaction: touch and explore objects in free space
- All-day-use without fatigue or nausea

Company Overview

- The most advanced Augmented Reality (AR) technology in the world
- Award-winning and patented Digital Light Shaping (DLS™) Technology
- Proven in medicalimaging: first holographic clinical trials in the world
- Fully-demonstrable technology: first product launch in 2017

- Established in 2008
- Headquarters in Yokneam - Israel
- Privately held, backed by top-tier investors

Digital Light Shaping™ (DLS) Technology

Real-time reconstruction of interference-based 3D volumetric holograms in “mid-air”
- The best method known to science to precisely reconstruct and display 3D objects in free space
- Contains all 3D visual depth cues at multiple focal planes
- Provides optical reality and not an optical illusion, not "fooling" the brain in any way

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Interactive holography was considered “not reachable in the near future”
The Fundamental Limitations of Existing (Stereoscopic) AR Solutions

- Provide an illusion of depth perception
- Produce an inaccurate 3D image
- Do not allow direct interaction with the image
- Support only a short user experience - will give the user a headache
- None are appropriate for medical/clinical applications

DLS™ by design does not carry any of these limitations

3D Medical Imaging - The Path to Holography

- Exponential advancement with 3D acquisition technologies and image processing capabilities
- All became high quality volumetric, full 3D screens becoming the bottleneck for medical imaging

3D Volumetric Medical Data

- 100% reliance on imaging
- Volumetric visualization of complex anatomy
- Navigation and device-tissue interaction
- Operator independence
- Communication within the medical team

The Needs in the Modernized Interventional Suite

- Extremely realistic 3D holograms floating “in air”
- Easily accessible and interactive real-time images
- Dynamic positioning of the system behind or in front of the operator
- Advanced optics allowing adjustable hologram location to accommodate various operators and procedure workflows (structural cardiology and electrophysiology)

Configuration subject to change as part of the R&D process - not commercially available.
3D Holography: image intimacy™ Capabilities

Interactive Live Holography for Interventional Cardiology

Medical Holography for Electrophysiology (LA)

3D Holographic TAVI - Simulation

First In-Human Clinical Trials

First in Human - Holographic Images

- Real-time clinical holographic images.
- 16 year-old girl with a moderate ASD secundum referred for transcatheter closure.
- Taken with a single lens camera (like a viewer looking with one eye) projected on a 2D screen.
HOLOSENSE - Clinical Applications

- All Valve Interventions
- LVAD
- TAVI Intervention
- Volumetric Biopsy
- Guided Treatments (NanoKnife, Cryo, HIFU...)
- Structural Cardiology
- Interventional Oncology
- Electro-physiology
  - AV Valve Interventions
  - LAAO
  - TAVI Intervention

HOLO Sentinel Clinical Applications

- Atrial Fibrillation

HOLOSENSE for Interventional Oncology

- Holographic projection unit displaying the 3-D image within the patient’s body
- Makes patient literally “see through”
- Enables operator direct 3D vision and intuitive spatial comprehension of lesions within the region of interest
- True depth facilitates accurate targeting of lesions with single or multiple needles or tools

HOLOSENSE Imaging for Interventional Tumor Ablation

Imaging is a critical component for all stages of treatment:

1. Planning
   - Assessment of lesion
   - Size
   - Shape
   - Number
   - Location relative to blood vessels and critical structures

2. Targeting
   - Clear delineation of tumor and surroundings
     - Multi-planar imaging
     - Interactive capabilities

3. Monitoring
   - Assessment of therapy effects
     - Intra-procedural modification
     - Assessment of treatment response

4. Outcome
   - Real-time vs. Post-procedure
   - Respiration influence

HOLOGRAPHY for Interventional Oncology

- Interventional Oncology
  - Spatial accuracy essential for tissue definition - haptics
  - Spatial accuracy essential for target tissue destruction
  - Spatial accuracy essential to avoid collateral damage

HOLOGRAPHY and Navigation for SHD vs. IO

<table>
<thead>
<tr>
<th>Feature</th>
<th>SHD</th>
<th>IO - Ablation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Access to organ</td>
<td>Vascular - contours</td>
<td>Percutaneous - straight line</td>
</tr>
<tr>
<td>Point of entry</td>
<td>Vascular - avoid potential damage</td>
<td>Percutaneous - avoid potential damage</td>
</tr>
<tr>
<td>Tissue Structural Clues</td>
<td>Present</td>
<td>Absent</td>
</tr>
<tr>
<td>Depth appreciation</td>
<td>Often tangible</td>
<td>Seldom tangible</td>
</tr>
<tr>
<td>Co-registration</td>
<td>Not important</td>
<td>[Almost] Essential</td>
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<tr>
<td>Accuracy needed</td>
<td>++</td>
<td>+++</td>
</tr>
<tr>
<td>Outcome</td>
<td>Real time</td>
<td>Post-procedure</td>
</tr>
<tr>
<td>Respiration influence</td>
<td>Minor</td>
<td>Major</td>
</tr>
</tbody>
</table>

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Clinical Benefits of 3D Medical Holography

- **Visualization** - true holography generated from real-time 3D volumetric medical data:
  - Provides all visual depth cues for a clear and accurate understanding of the spatial information in free 3D space
  - Affords enhanced confidence for intuitive navigation and exact interaction with patient's anatomy
  - "Intuitive anatomy" resulting in shorter learning curves, reduced procedure and radiation time and improved outcome

- **Ultimate Natural User Interface (NUI):**
  - Unbounded interaction with the image: rotate, move, zoom, mark, measure (all in true 3D space)
  - "In-air" 3-D image provided at hands-reach allows the clinician independent control over the image during the procedure.

Global Interest and Media Coverage

- **Established Clinical Recognition**

- **Clinical Benefits of 3D Medical Holography**