3D Ultrasound Navigation System with Reconstruction of Blood Vessel Network for Microbubble Delivery Therapy


Ultrasonic Microbubble Delivery
Microbubble control in blood vessel by ultrasound
• Gene/drug delivery
• Effective thermal therapy (HIFU)

Purpose
Development of 3D ultrasound navigation system with a reconstruction algorithm of a blood vessel network for microbubble delivery therapy
Methods

Navigation System Configurations
- 3D Echography (iU22, Philips)
- 3D Ultrasound Probe (X6-1, Philips)
- Optical Tracking Device (Polaris Spectra, NDI)
- Ultrasound Transducers
- Navigation Software

The guidance of Microbubble Delivery
The navigation system visualizes the relative position between a target bifurcation and a focal spot of a transducer

\[ S T_B = S T_{Tr} \cdot T_G \cdot T_{Pr} \cdot T_{Vol} \cdot V_{TB} \]

<table>
<thead>
<tr>
<th>Microbubble</th>
<th>F-04E</th>
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</thead>
<tbody>
<tr>
<td>Artificial blood vessel</td>
<td>PEG, 2.0 mm inner diameter</td>
</tr>
<tr>
<td>Aggregation forming sound field</td>
<td>2.7 mm spot (5 MHz, 300 kPa)</td>
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<tr>
<td>Microbubble induction sound field</td>
<td></td>
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<tr>
<td>Flow rate</td>
<td>50 mm/s</td>
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</table>
Results

Navigation accuracy validation by microbubble induction tests

※ Jig : The induction index in the optimal positioning by conventional approach  
Navi : The induction index under the guidance of the navigation system

The result suggests that there was no significant difference between conventional approach and developed system