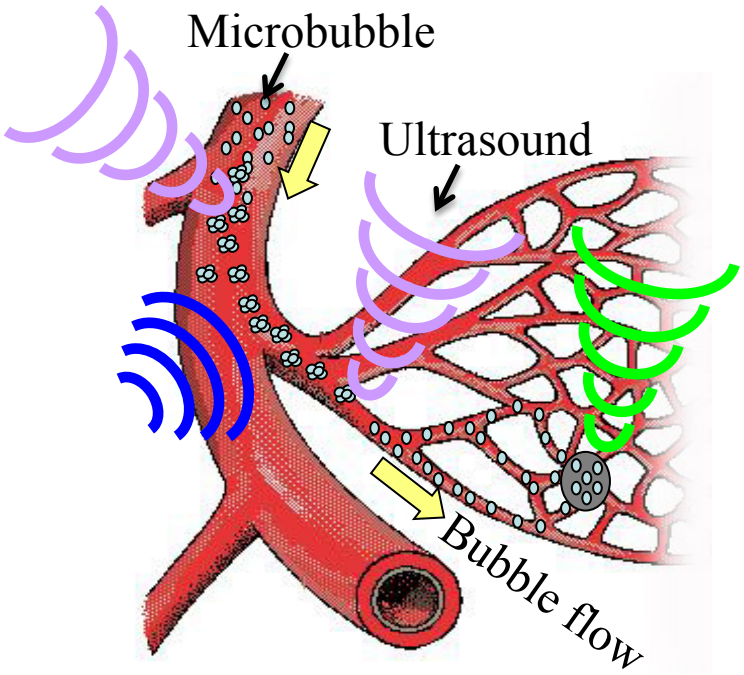
3D Ultrasound Navigation System with Reconstruction of Blood Vessel Network for Microbubble Delivery Therapy

S. Onogi, *T.H. Phan, A. Bossard, N. Hosaka, R. Koda, T. Mochizuki, K. Masuda
Grad. Sch. Bio-Appli. Syst. Eng., Tokyo Univ. of Agri. & Tech.



Ultrasonic Microbubble Delivery

Microbubble control in blood vessel by ultrasound

- Gene/drug delivery
- Effective thermal therapy (HIFU)

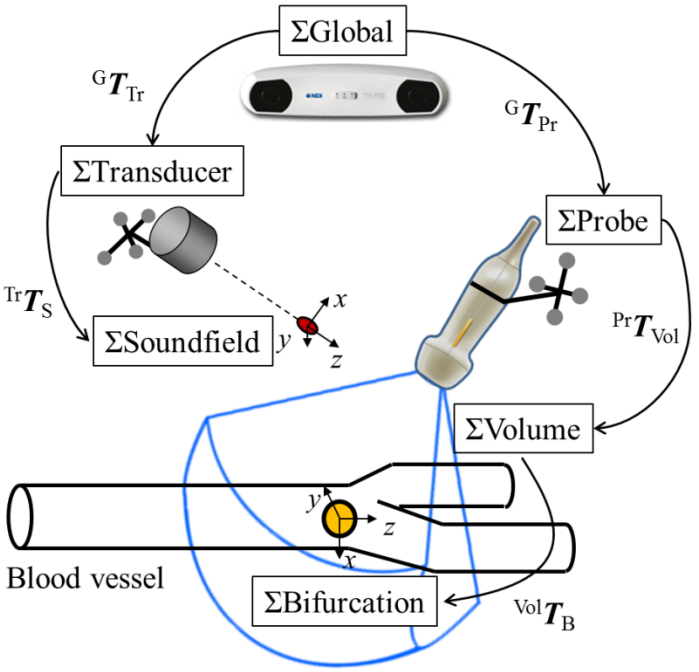
Purpose

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

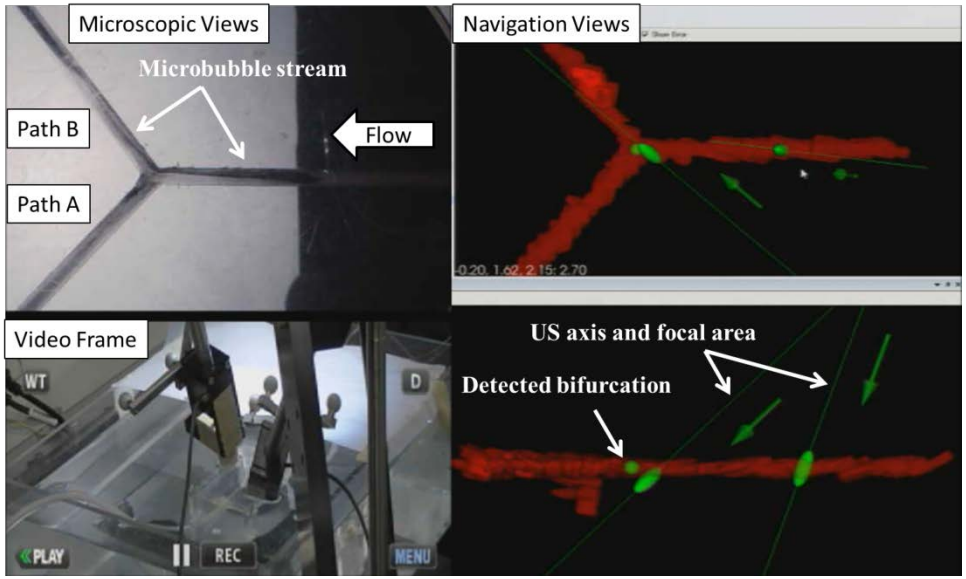
The navigation system visualizes the relative position between a target bifurcation and a focal spot of a transducer

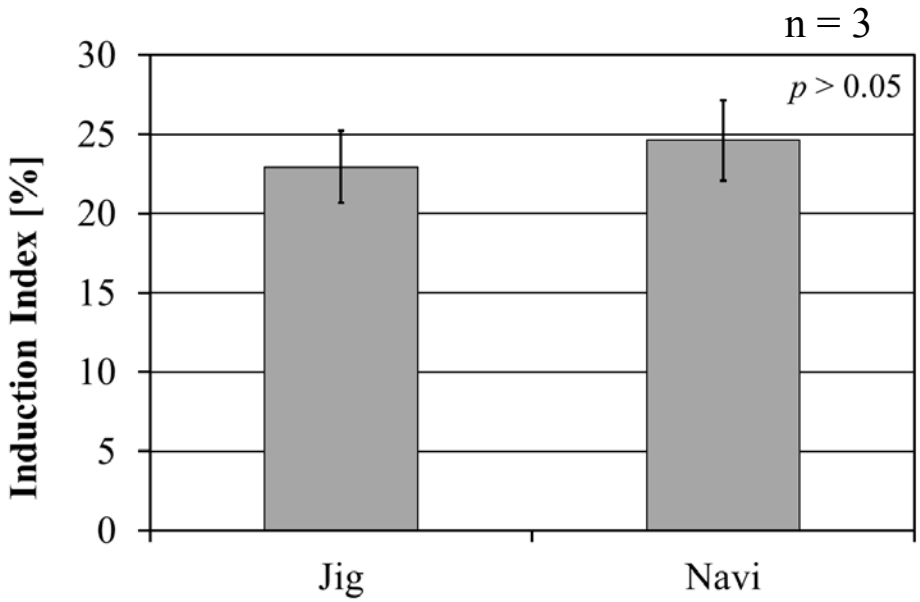
$$ {}^{S}\boldsymbol{T}_{B} = {}^{S}\boldsymbol{T}_{Tr}\,{}^{Tr}\boldsymbol{T}_{G}\,{}^{G}\boldsymbol{T}_{Pr}\,{}^{Pr}\boldsymbol{T}_{Vol}\,{}^{Vol}\boldsymbol{T}_{B} $$

Microbubble	F-04E
Artificial blood vessel	PEG, 2.0 mm inner diameter
Aggregation forming sound field	2.7 mm spot (5 MHz, 300 kPa)
Microbubble induction sound field	
Flow rate	50 mm/s

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