

## Description of Additional Supplementary Files

**File Name:** Supplementary Movie 1

**Description:** Adaptive transport in tortuous channels. Unsupervised advancement of a  $\mu$ -probe by fluidic stresses in a tortuous channel.

**File Name:** Supplementary Movie 2

**Description:** Crucial role of flow. Demonstration showing the buckling of a  $\mu$ probe that is pushed in the absence of flow. The motion of the ultraflexible structure is driven by the flow in the channel.

**File Name:** Supplementary Movie 3

**Description:** Numerical simulation of  $\mu$ -probe transport. Simulation of  $\mu$ -probe motion inside a tortuous channel.

**File Name:** Supplementary Movie 4

**Description:** Autonomous navigation in stenotic occlusions. Demonstration of autonomous obstacle avoidance and navigation in the presence of exaggerated stenotic conditions.

**File Name:** Supplementary Movie 5

**Description:** Magnetic field sweep. Influence of the applied magnetic field on the dynamics of the  $\mu$ -probe pose under viscous flow.

**File Name:** Supplementary Movie 6

**Description:** Controlled-Lift (CL) navigation. Description of the CL navigation method for the steering of the  $\mu$ -probe into the chosen target daughter vessel.

**File Name:** Supplementary Movie 7

**Description:** Controlled-Heading (CH) navigation. Description of the CH navigation method for the steering of the  $\mu$ -probe into the chosen target daughter vessel.

**File Name:** Supplementary Movie 8

**Description:** Numerical analysis of CL and CH navigation. Simulation results showing the conceptual differences in daughter artery selection using CL or CH navigation methods.

**File Name:** Supplementary Movie 9

**Description:** Navigation in narrow channel. Navigation in channels slightly larger than the size of the probe head.

**File Name:** Supplementary Movie 10

**Description:**  $\mu$ -Probe navigation in ex vivo perfused rabbit ear. Proof-of-concept CH navigation inside perfused arterial microvasculature of ex vivo rabbit ear.

**File Name:** Supplementary Movie 11

**Description:** Navigation and dye injection in ex vivo perfused rabbit ear. Proof-of-concept navigation and injection of optical contrast liquid through a 40  $\mu\text{m}$ -inner diameter ultraflexible magnetic  $\mu$ -catheter inside an ex vivo perfused arterial microvasculature