

## Smart Materials and Structures

### Damage detection in composite materials and novel deployable structures

When small devices for damage detection or new deployment mechanisms are integrated into traditional structural members, they become smart structures. Especially, we are developing high-sensitive optical-fiber ultrasonic sensors built in aircraft structures and structural health monitoring or NDE methods using ultrasonic guided waves. Moreover, novel deployable structures are proposed based on geometry of Origami and wings of insects.

- ◆ High performance fiber-optic ultrasonic sensors: High sensitive damage monitoring in composites
- ◆ Advanced NDE system suitable for FRP: Theoretical clarification of laser-ultrasonic waves
- ◆ Damage detection in composite structures based on the mode conversion of Lamb waves
- ◆ Innovative deployable structures based on insect wing mechanisms and Origami

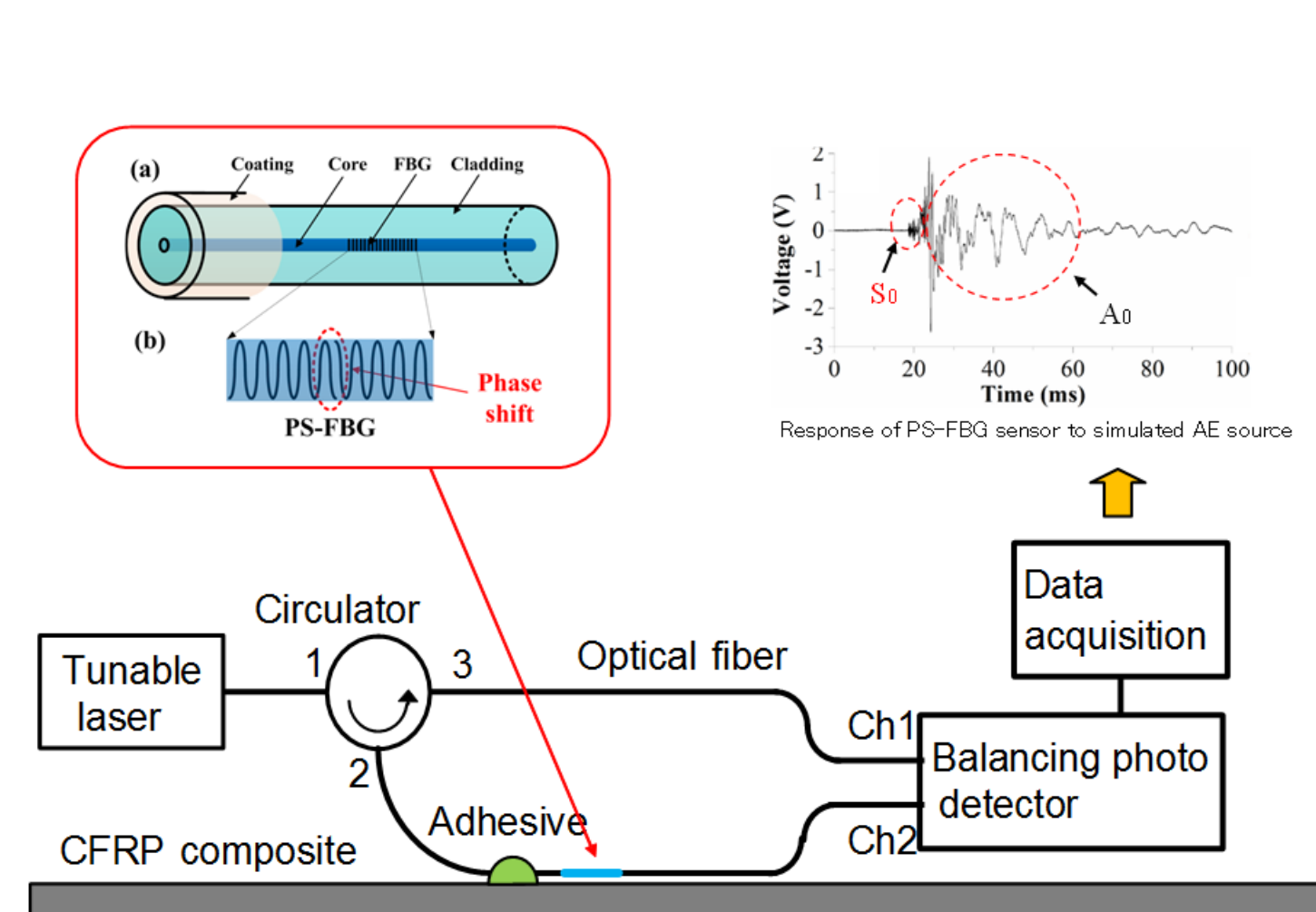


Fig. 1 AE detection by fiber-optic ultrasonic Sensor based on phase-shifted FBG

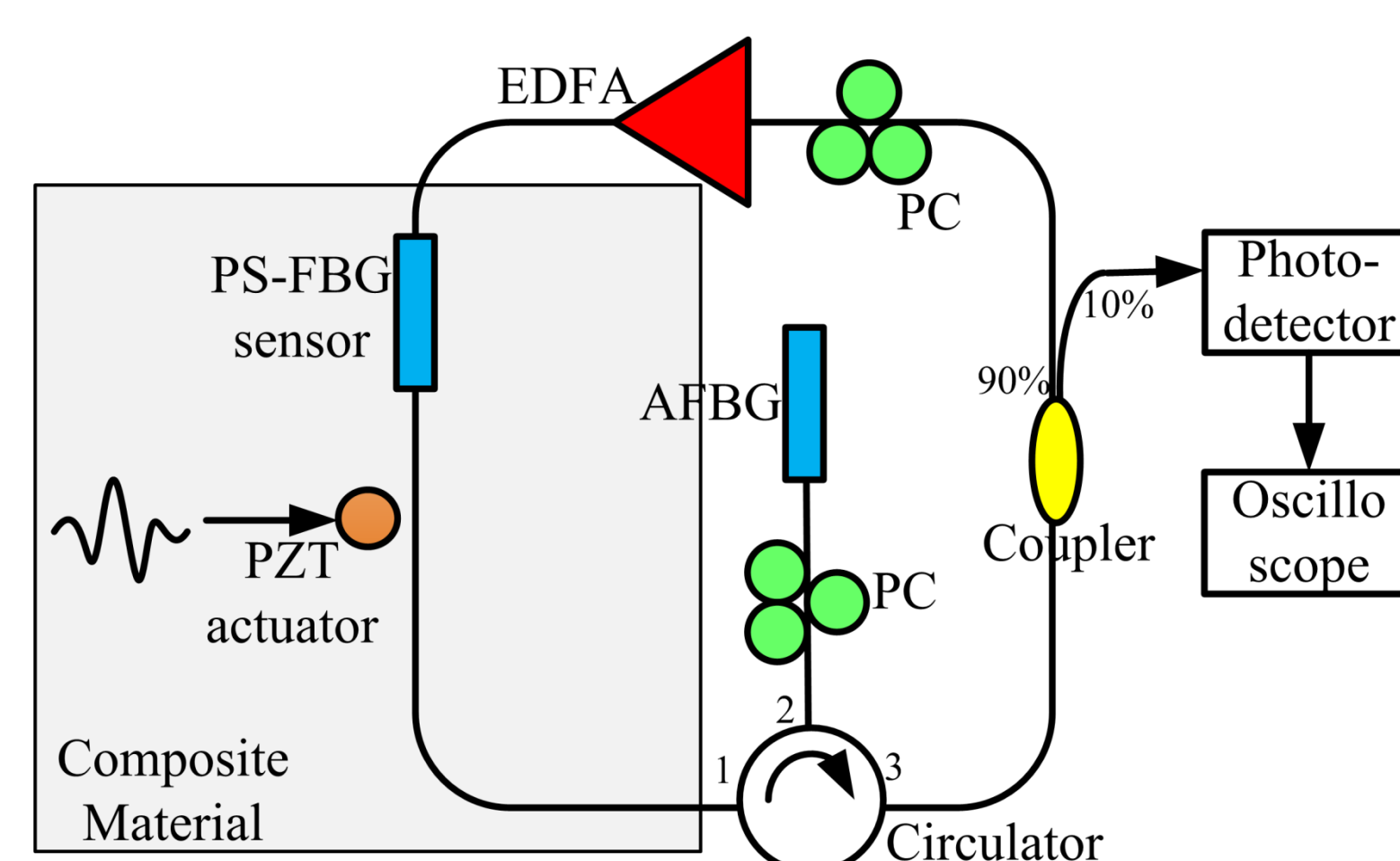


Fig. 2 Laser-sensor system with ultrasensitive, ultra-broadband, and self-adjustment function for disturbance

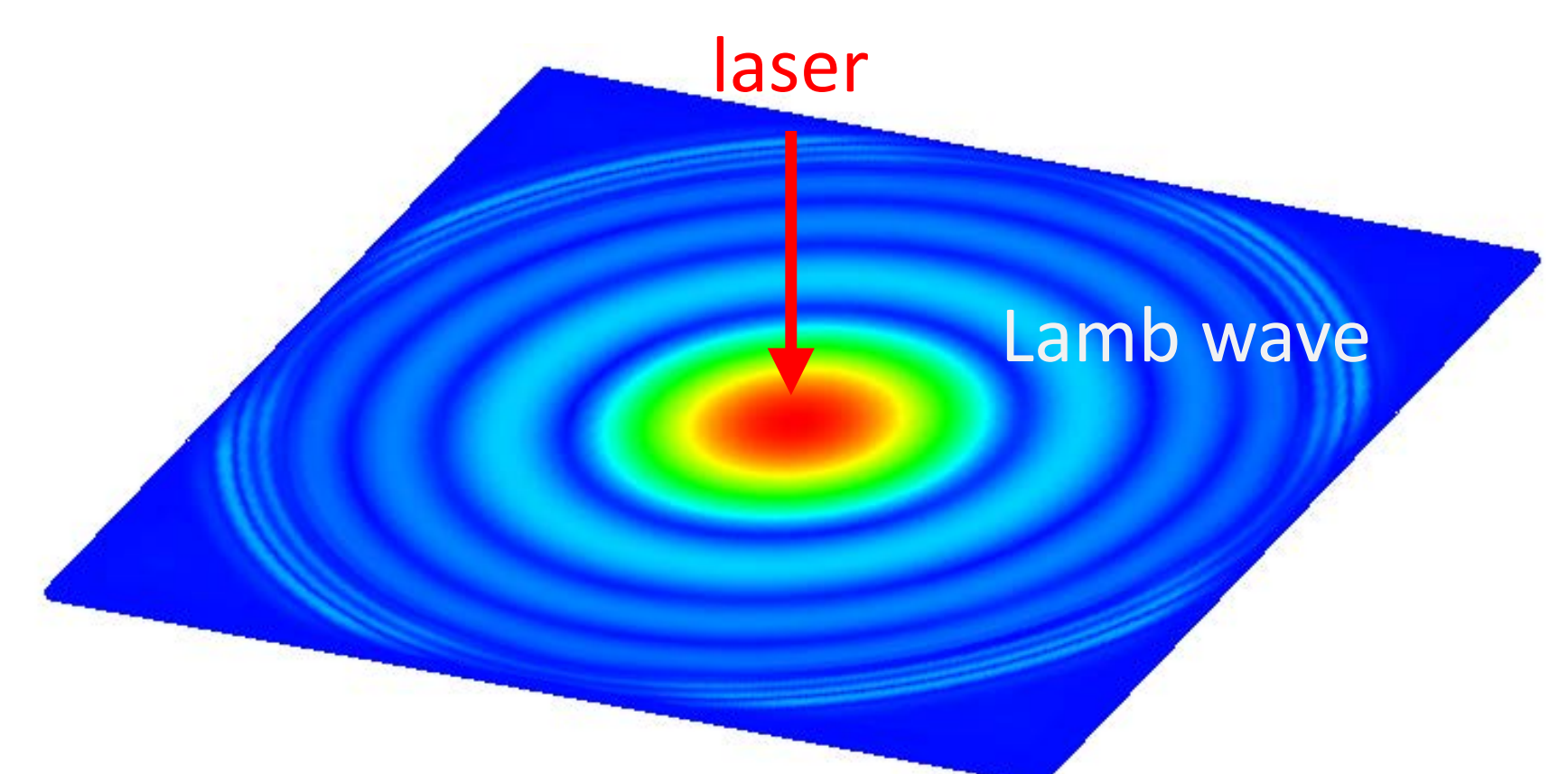


Fig. 3 FEM simulation of Lamb wave propagating in a CFRP composite laminate

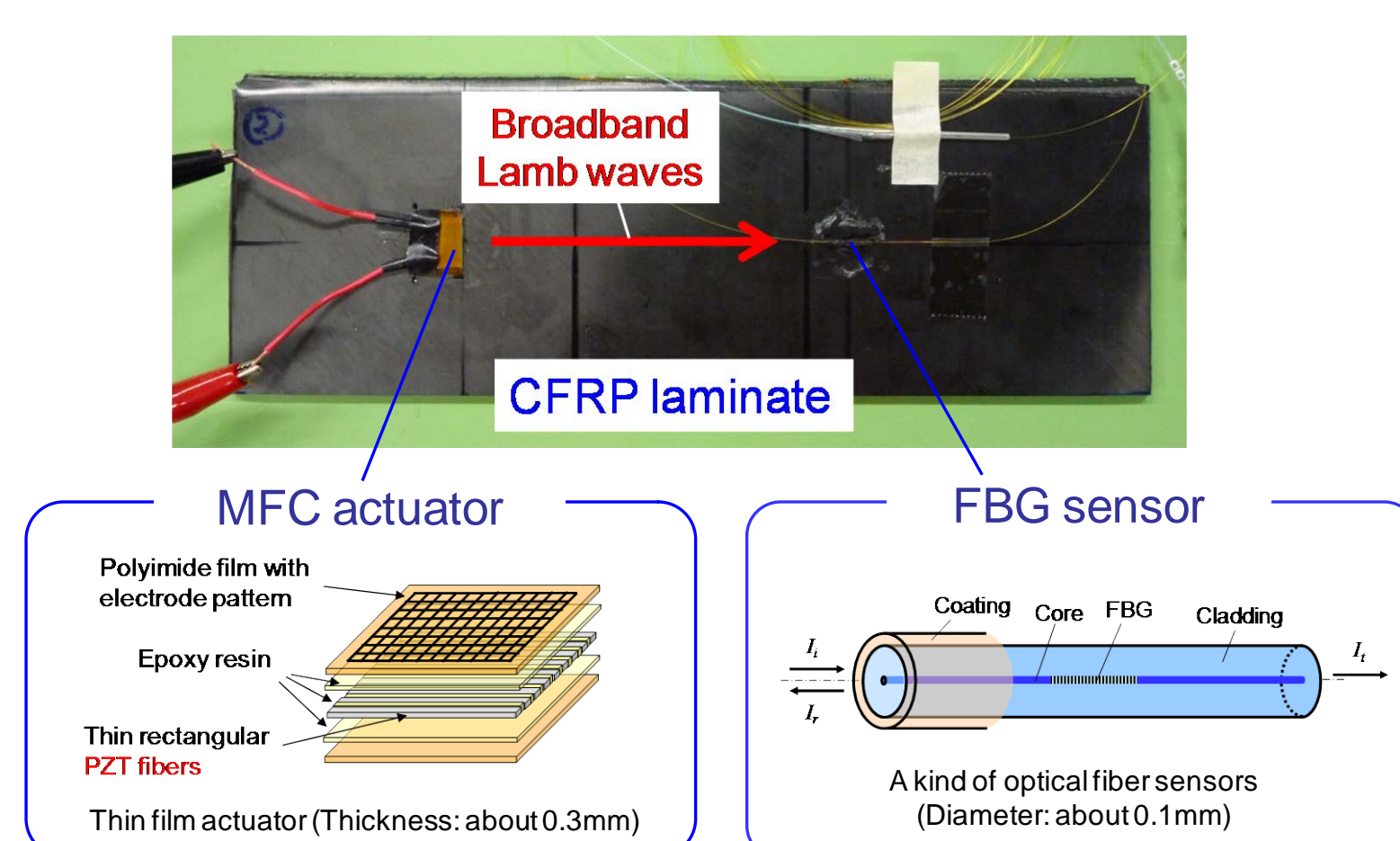


Fig. 4 Ultrasonic propagation system integrated into composite laminates

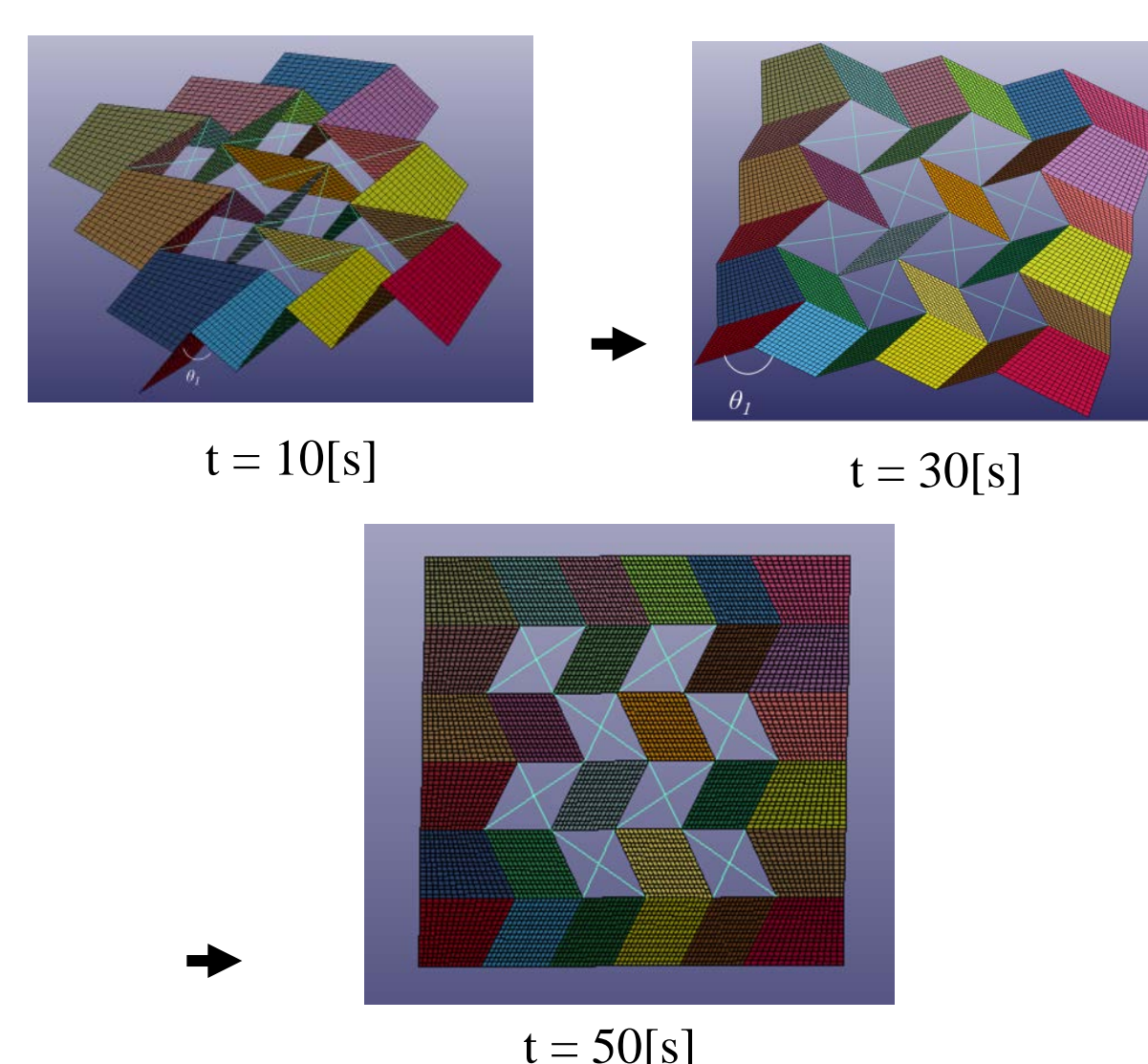


Fig. 5 Self-deploying Origami models using geometrically misaligned crease patterns

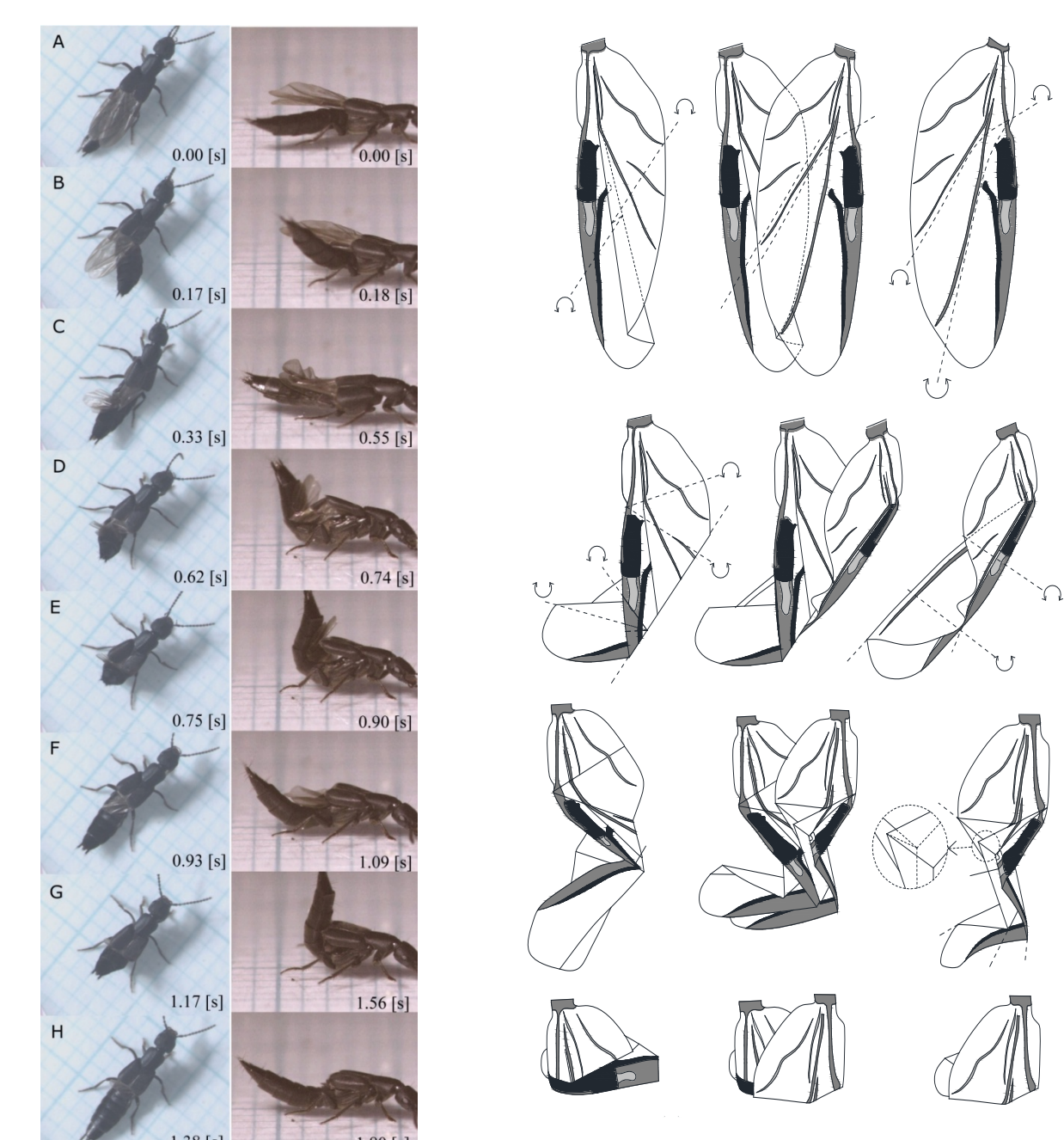


Fig. 6 Wing folding motions of rove beetles imaged with a high-speed camera