RIVERFIELD Inc.

Surgical Robot Laboratory

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Tokyo, Japan

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Our Key Technology

Precise control of pneumatic system

Feature of pneumatic drive

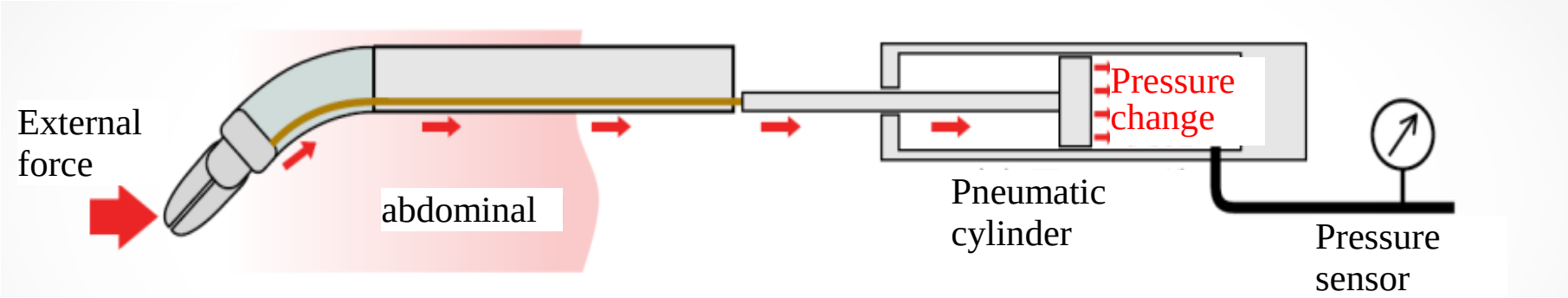
- Passive softness through the compressibility of air ⇒ Human affinity
- High weight/output ratio makes usage without gears possible

⇒ High back drivability

× Easily affected by friction, etc

○ External detection using pressure

Image of external force estimation

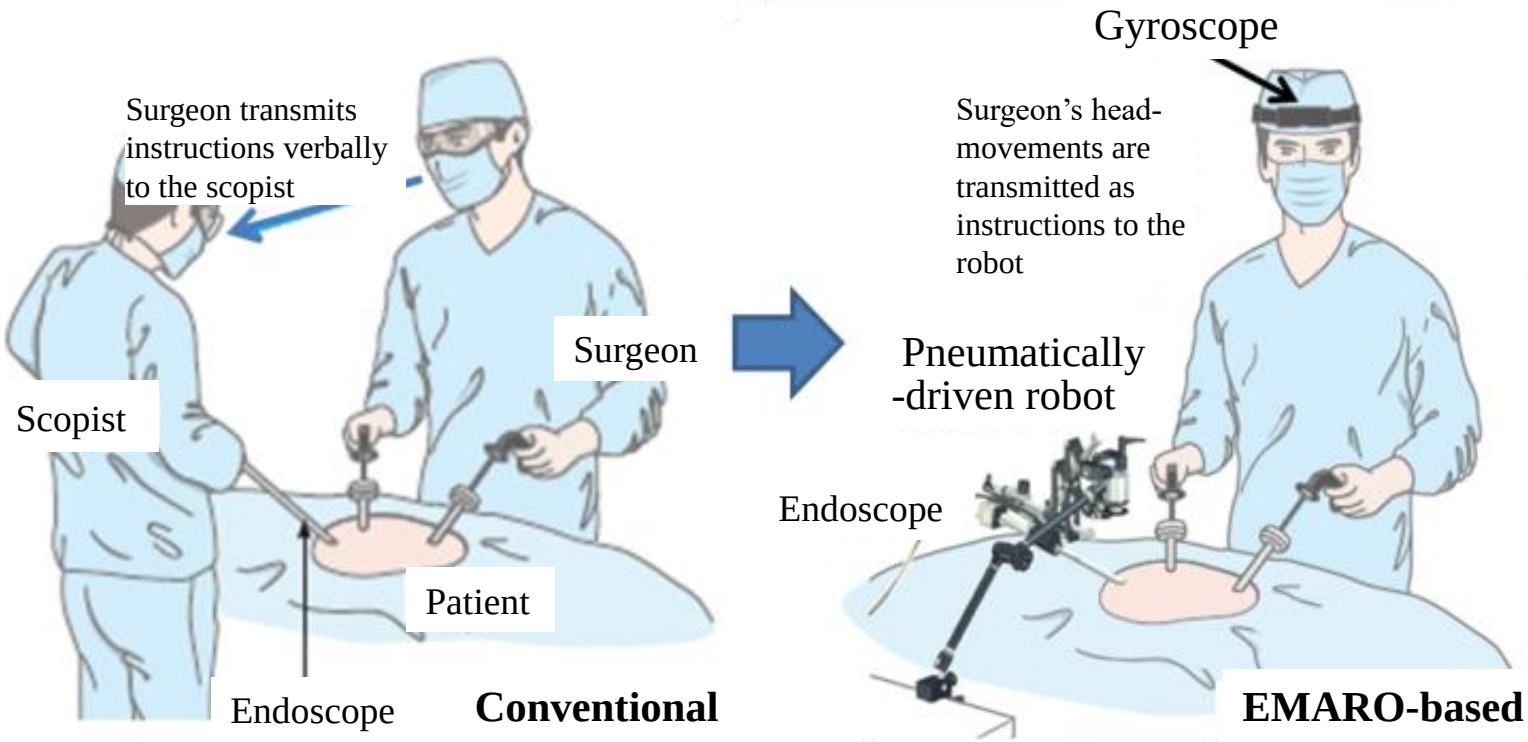


① External force is applied at the tip of the forceps
② The force is transmitted to the pneumatic cylinder
③ The pressure in the pneumatic cylinder changes
④ The force is calculated from the pressure

Laparoscope holder named EMARO

＜Concept＞

Provide a desired view with an intuitive operation



- ✓ Robot arm holds the endoscope
- ✓ Vision field is controlled by head tracking

Kotaro Tadano and Kenji Kawashima,
The International Journal of Medical Robotics and Computer Assisted Surgery, 11(3), 331-340, 2015

Specifications of EMARO

EMARO (registered trademark)

Clinical use

Safety

- Precise force control with pneumatic drive
- 5 speeds for each axis of motion

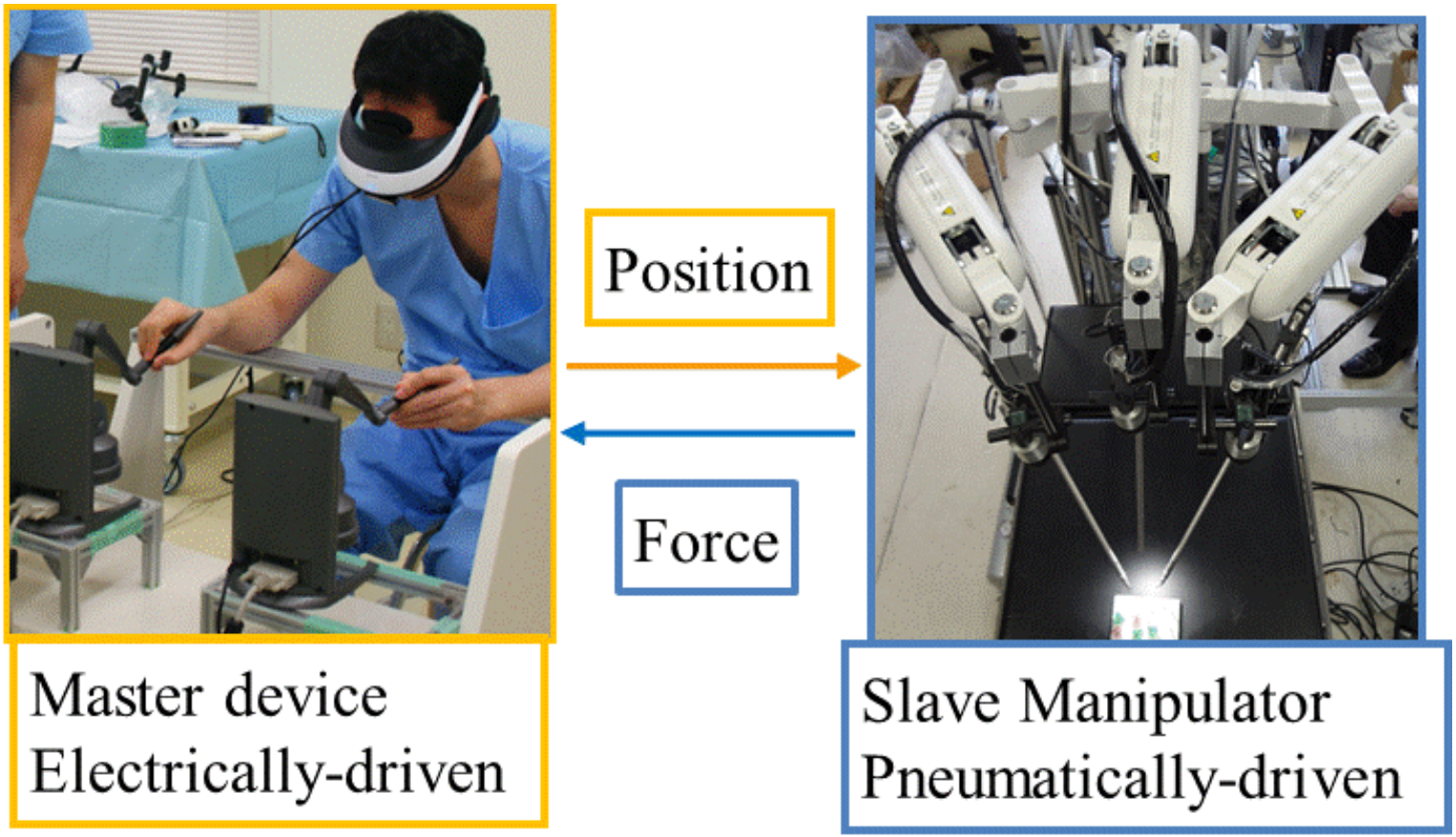
Usability

- Hands free operation
- Three operational interfaces
  - Head sensor (vertical, lateral)
  - Foot switch (longitudinal, rotational)
  - Manual switch (vertical, lateral, longitudinal, rotational)
  - Console panel (vertical, lateral, longitudinal, rotational)

Functionality

- 4DOFs (vertical, lateral, longitudinal, rotational)
- Applicable to commercially available rigid endoscopes (ϕ10mm, ϕ5mm)

Prototype of Pneumatically-driven Surgical Robot



System configuration of master-slave system

The force applied at the tip of the forceps is estimated from the pressure difference of pneumatic cylinder place at the end of the forceps. The tip part can be easily cleaned and sterilized.

Kotaro Tadano and Kenji Kawashima,
Advanced Robotics, 24(12), 1763-1783, 2010

Feature of Pneumatically-driven Surgical Robot

Lightweight and Compact

- Simple structure with pneumatic drive

Delicate Manipulation

- Soft and precise force control

Force Display

- Estimate the force at the tip from the pressure