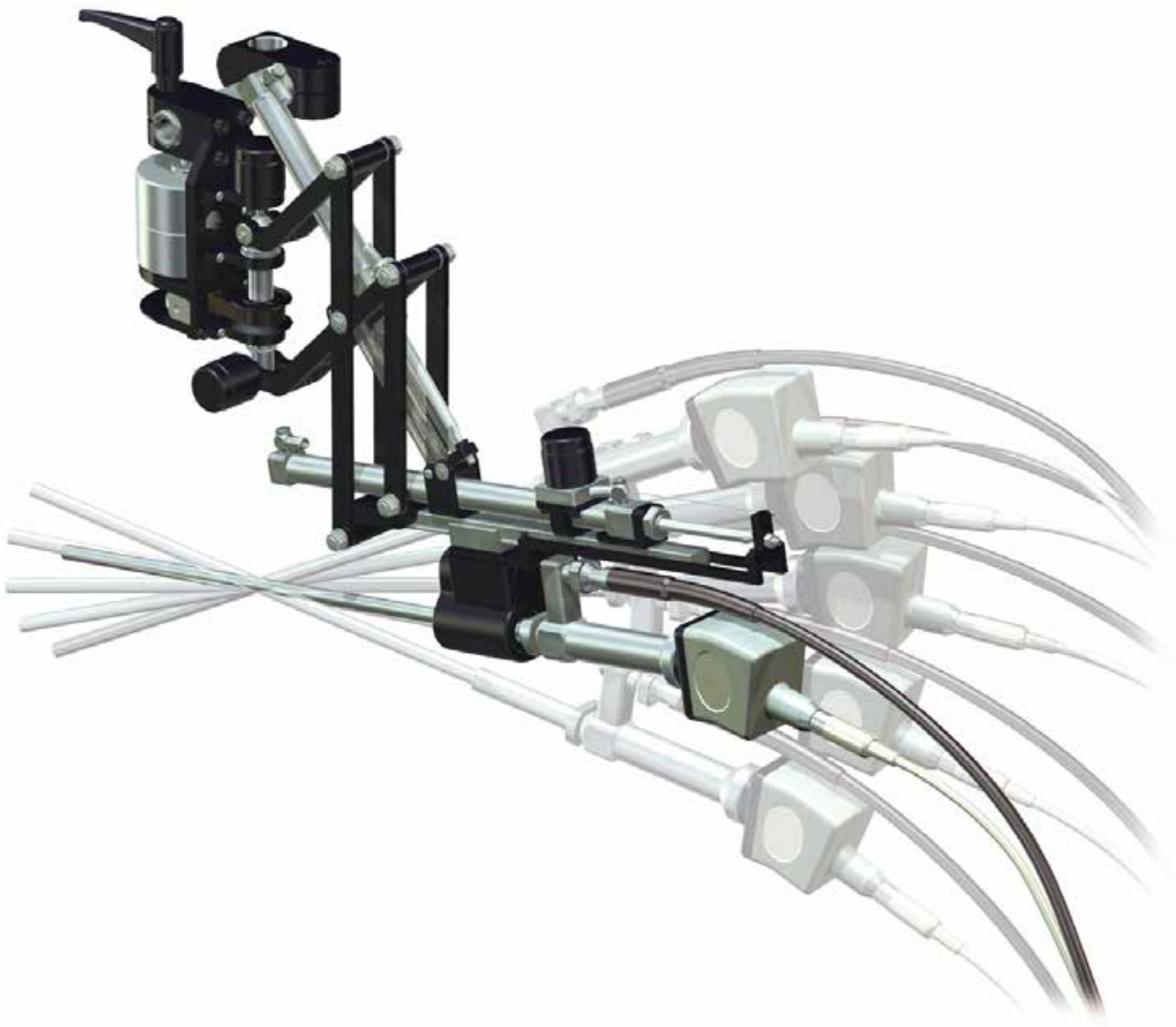

Aerovision

Head Sensor Linked, Pneumatic Endoscope Robotic Holder

Surgical system that respects surgeon's commandes with 99.99% accuracy



Outdoing even highly skilled endoscopists?!

Supporting smoother surgery by guiding the endoscope just the way you want it

The popularity of endoscopic operations is rising rapidly due to the minimal physical burden on patients. In cases where endoscopes are manually guided by endoscopists, serious issues exist such as smooth communication with the surgeon, hand movement and so on.

Aerovision is an endoscope holder which substitutes the role of the endoscopist by holding the endoscope in a robotic arm and linking with high accuracy to the movement of a sensor attached to the surgeon's head to operate the endoscope.

There is no hand movement, which means a stable field of vision is possible. It may not even be going too far to say that this intuitive operation of the endoscope linked to head movement may even exceed the level of a highly skilled endoscopist.

Issues with endoscopic operation to date

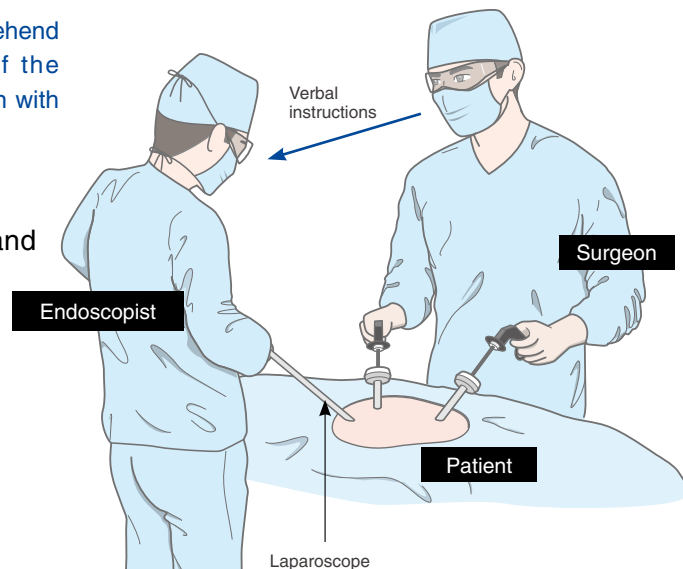
Endoscopists need familiarization

Endoscopists need to sufficiently comprehend and be familiar with the content of the surgery to make smooth communication with the surgeon possible.

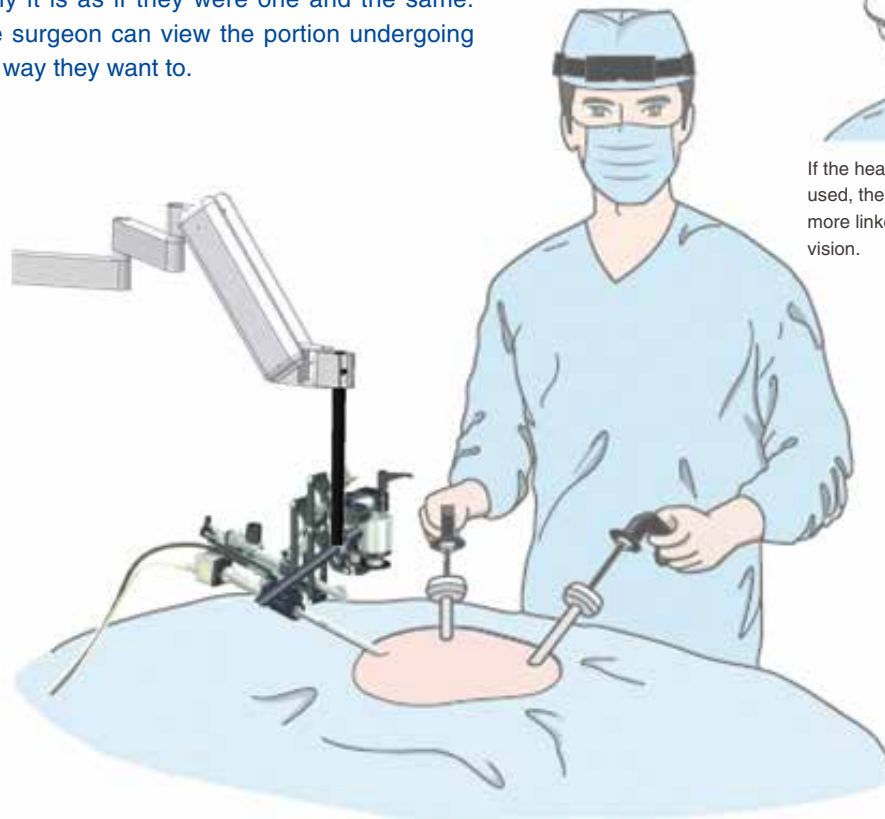
Unstable field of vision due to hand movement

It requires much more effort to focus on the patient or forceps if the field of vision is unstable.

Also, if a 3D head mount display is used, 3D images can easily bring on a feeling of wooziness and this is an even greater problem.



An angle sensor detects movement of the surgeon's head. The robot arm moves in sync with the endoscope to match the direction and distance that the head moved. The surgeon's head and the endoscope movement are linked so closely it is as if they were one and the same. This means the surgeon can view the portion undergoing surgery just the way they want to.



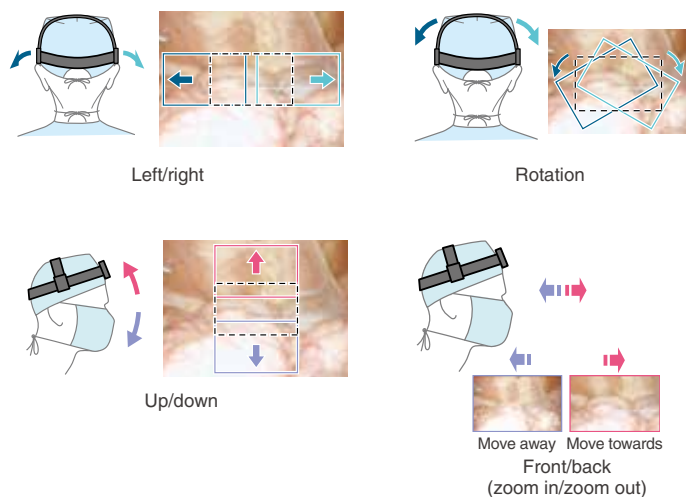
If the head mount display is used, the surgeon feels even more linked with their field of vision.

Issues related to operation by endoscopists such as difficulty in communication due to verbal instructions and hand movement due to fatigue are solved and stable images increase the level of intuition during surgery higher than ever before.

● Head sensor and field of vision are linked in 4 degrees of freedom

The movement of the sensor attached to the surgeon's head is linked with the images (endoscope's vision) which appear on the display in 4 degrees of freedom. These are up/down, left/right, rotation and front/back (zoom in/zoom out).

This makes it possible to perform operations just as if you were directly looking at that portion with your own eyes.



“Pneumatic drive” concept

High safety factor achieved due to compact and light movement

Aerovision features soft, smooth operations made possible by pneumatic drive. That softness makes it possible to easily move the holding arm during drive-control by hand. When the endoscope moves and touches the patient’s organs, it does so gently and softly, not inflicting any harm. In addition, an upper limit can be set for the holding arm to prevent it from moving when more than the set force is applied. A movement range can also be set for the holding arm. The design incorporates multiple measures to secure safety.

Mechanism-wise, Aerovision is extremely quiet, and can be used without any problems in the operating room, which is a big advantage. A groundbreaking endoscope holder never before seen made possible from the pneumatic drive concept.



● So soft it can be moved by hand even during drive

The movement of the holding arm is extremely soft because the air used for drive acts as a buffer against external force applied on the holding arm. Even during drive control, the arm can be easily stopped and moved by hand. This is virtually impossible if motor drive, etc. is used. It is only something that can be achieved with pneumatic drive.

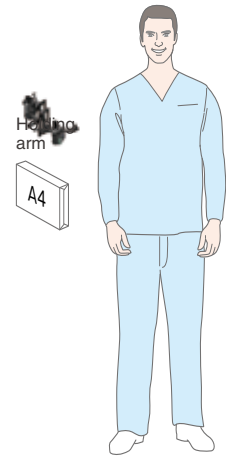
Softness can be set arbitrarily to suit the portion undergoing surgery and the patient’s internal condition therefore the surgeon can perform surgery at their desired level of safety.

Lightweight (0.9 kg) and small (A4 size)

Because pneumatic drive is adopted, there is no motor, etc., meaning the holding arm is extremely light and compact.

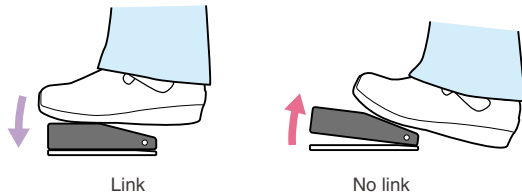
The arm is amazingly light at only 0.9 kg and only about as big as a stack of A4 paper (500 pieces).*

* 209 mm x 276 mm x 41 mm (Excluding protruding portions)



Break linkage instantly

The head sensor and holding arm are only linked while the surgeon is stepping on the foot pedal. As soon as the surgeon releases the foot pedal, the link with the holding arm is broken and it will stop in its current position.

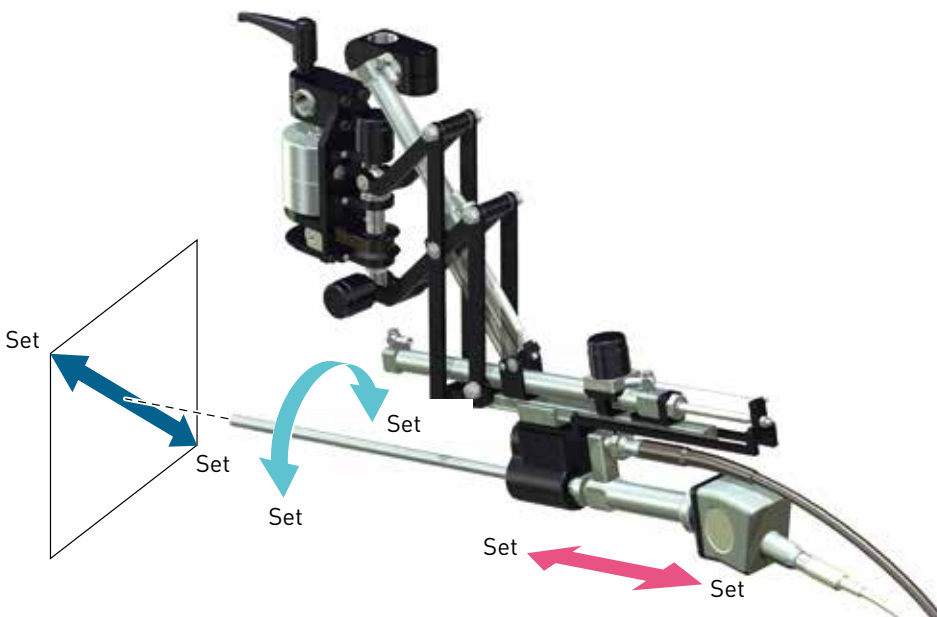
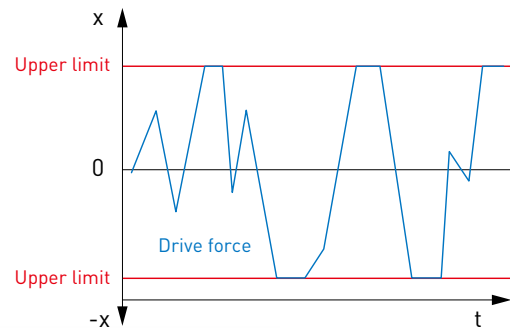


Able to set drive force upper limit

If an upper limit is set for arm drive force (maximum generated power), the supplied pressure will be automatically adjusted with a decompression valve. If an upper limit is set to suit the patient's internal condition, damage to the organs by the endoscope will be avoided. It will also be possible to safely get close to the portion which the surgery is targeting.

Arbitrary setting of holding arm movement range

By moving the holding arm by hand and teaching the maximum moving range, it is possible to limit the range in which the holding arm moves. The user can arbitrarily set the maximum position in both positive and negative directions for all 4 degrees of freedom.



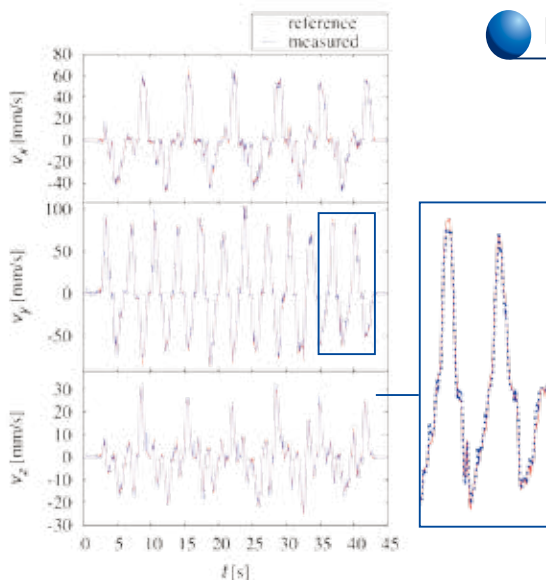
Pursuing a sense of “unity” and “flexibility”

An uncompromising approach converted to surprising user-friendliness

The surgeon can feel a strong and stress-free sense of unity thanks to the field of vision following the surgeon’s head movements perfectly with hardly any time lag.

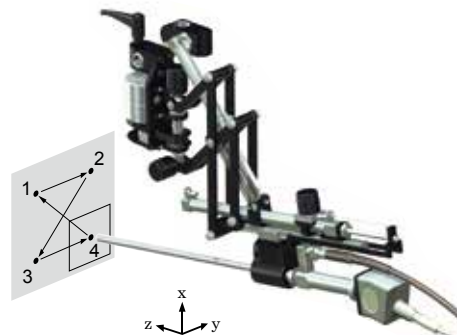
Also, the ratio of the head and holding arm operation speed can be adjusted arbitrarily. It can be set to the optimal speed for the surgeon and type of surgery.

Various commercially-sold endoscopes can be used, and if a 3D endoscope is used together with the 3D head mount display, a more realistic sense of depth and distance is possible.



High following ability – the source of unity

AeroVision’s holding arm follows head movements perfectly. From the graph verifying following ability, it can be observed that there is only a very miniscule amount of time lag between the head movement (indicated by the red line-) and the endoscope (indicated by the blue line -----), therefore proving the extremely high following ability. This creates a strong, stress-free sense of unity.



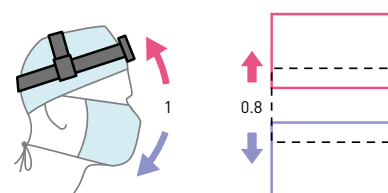
<Following ability verification method>

At a position approximately 100 mm from the tip of the endoscope, an A4 piece of paper with 4 points written on it was placed in front of the arm. In the order shown in the figure, the endoscope was operated using head movements so that each point would be positioned in the middle of the field of vision.

Arbitrarily adjustment of the head and holding arm speed ratio

Speed can be adjusted to the ratio easiest for the surgeon to control, e.g. to make endoscope movement slower than head movement in order to look closely at narrow places.

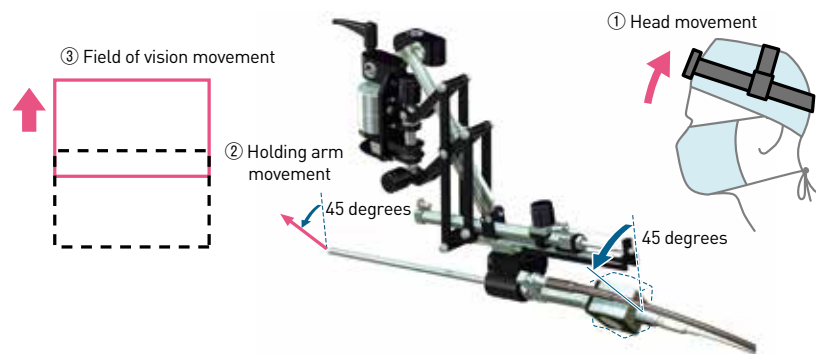
Speed ratio in each of the 4 directions can be adjusted independently meaning it is possible to make movement in particular directions fast and movement in other directions slow.



Movement of the holding arm controlled to link head movement and field of vision movement

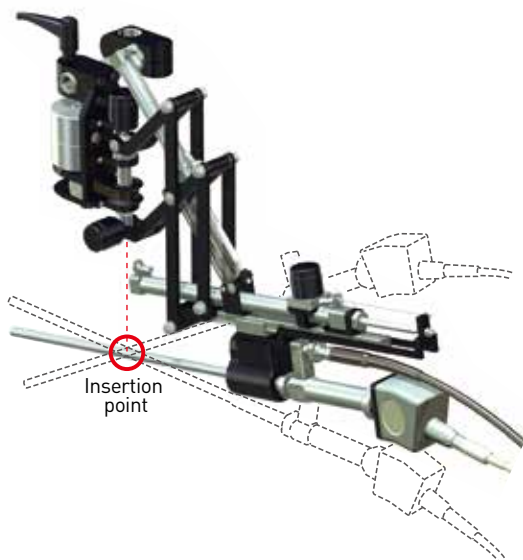
AeroVision calculates and controls optimal movement of the holding arm in order to make head movement and field of vision movement consistent. For example, if the endoscope is mounted at 45 degrees, when the head moves up (as shown in [1]) the holding arm (2) will move 45 degrees and the field of vision (3) will move upwards.

AeroVision, regardless of the positional relationship between the endoscope camera and the holding arm, is controlled so there will be suitable linkage between head and field of vision movements.



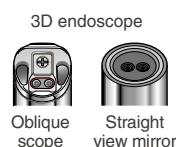
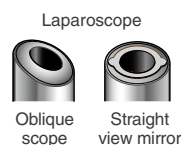
Insertion point within patient's body is fixed even if the holding arm moves

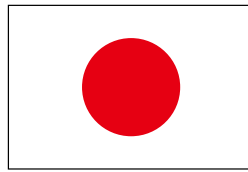
Regardless of how the holding arm moves, the insertion point inside the patient's body remains stationary. This is because AeroVision is designed by combining a parallel link mechanism and gimbal mechanism so that the holding arm's operations center on the endoscope's insertion point.



Supporting various commercially-sold endoscopes

AeroVision supports virtually all hard scopes used in endoscopic surgery such as laparoscopes and thoroscopes. Naturally it accommodates straight scopes and oblique scopes, and if a 3D endoscope is used together with the 3D head mount display, a more realistic sense of depth and distance is possible.





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