

Technical Solutions

This invention according to claim 1 is a robotic endoscopy system comprising: (a) at least one flexible elongate assembly configured to perform endoscopic procedures according to forces generated by external actuation elements; (b) a transport endoscope having a main body and a flexible elongate shaft comprising a central axis and a plurality of channels therewithin for carrying portions of the at least one flexible elongate assembly; (c) a docking station configured to be detachably engaged with the transport endoscope, the docking station having a translation unit configured to be matingly engaged with the at least one flexible elongate assembly and to selectively longitudinally translate the at least one flexible elongate assembly across a predetermined distance range; (d) a motorbox comprising a plurality of actuators configured to drive each of the at least one flexible elongate assembly; (e) a main control unit configured to control each of the plurality of actuators according to external control signals, and a docking mechanism comprising a joint member located at the transport endoscope; (f) a counterpart joint member located at the docking station; and (g) a locking mechanism to engage the joint member with the counterpart joint member; wherein the docking mechanism is positioned to allow the transport endoscope to detach from the docking station from one of (i) a same direction that the at least one flexible elongate assembly is matingly engaged with the translation unit, or (ii) a direction parallel to the central axis of the flexible elongate shaft.

positive pressure, suction, negative pressure, vacuum pressure, and irrigation through the flexible elongate shaft of the endoscopy system.

5 This invention according to claim 3 has, in the robotic endoscopy system of claim 1, a characteristic in that at least one of the flexible elongate assemblies is an actuation assembly comprising a robot arm and a corresponding end effector configured to perform endoscopic procedures according to forces generated by external actuation elements; a plurality of tendon elements configured to transmit forces generated by the external actuation elements to the robot arm and the end effector; and an adapter
10 configured to couple the plurality of tendon elements with the external actuation elements.

This invention according to claim 4 has, in the robotic endoscopy system of claim 3, a characteristic in that the motorbox comprises at least one adapter, one of the adapters
15 of the motorbox being coupled to the adapter of the actuation assembly.

This invention according to claim 5 has, in the robotic endoscopy system of claim 1, a characteristic in that each of the flexible elongate assemblies further comprises a collar element configured to surround at least a portion of an outer sleeve of the
20 flexible at a predetermined distance away from a distal end of the end effector and configured to enable longitudinal translation of at least one of the flexible elongate assemblies across a predetermined distance range.

This invention according to claim 6 has, in the robotic endoscopy system of claim 5, a
25 characteristic in that the translation unit comprises at least one receiver configured to be matingly engaged with the collar element to enable the longitudinal translation.

This invention according to claim 7 has, in the robotic endoscopy system of claim 3, a characteristic in that at least one of the flexible elongate assemblies is a flexible
30 imaging endoscope assembly comprising an imaging unit configured to capture images of the end effectors of the robot arms; a plurality of tendon elements configured for spatially positioning the imaging unit in response to applied forces; and an adapter by which

the plurality of tendon elements of the flexible imaging endoscope assembly can be interfaced with particular external actuation elements.

5 This invention according to claim 8 has, in the robotic endoscopy system of claim 1, a characteristic in that a portion of the main body has a shape of a cuboid tube.

10 This invention according to claim 9 has, in the robotic endoscopy system of claim 1, a characteristic in that the joint member located at the transport endoscope is formed on a side surface of the main body.

15 This invention according to claim 10 has, in the robotic endoscopy system of claim 1, a characteristic in that the joint member located at the transport endoscope comprises a groove and slots; and the counterpart joint member located at the docking station comprises a protrusion and bumps, the groove and the slots for accommodating the protrusion and the bumps.

20 This invention according to claim 11 has, in the robotic endoscopy system of claim 1, a characteristic in that the joint member located at the transport endoscope comprises a clamping member to accommodate a slot of the counterpart joint member located at the docking station.

25 This invention according to claim 12 has, in the robotic endoscopy system of claim 1, a characteristic in that the locking mechanism comprises a locking lever provided on the counterpart joint member located at the docking station.

This invention according to claim 13 has, in the robotic endoscopy system of claim 1, a characteristic in that the locking mechanism comprises release buttons provided on the counterpart joint member located at the docking station.

30 This invention according to claim 14 has, in the robotic endoscopy system of claim 1, a characteristic in that the main body further comprises a plurality of insertion inlets disposed at a proximal end of the main body, through which the plurality of channels are accessible.

Claims

1. A robotic endoscopy system, comprising:

at least one flexible elongate assembly configured to perform endoscopic procedures according to forces generated by external actuation elements;

5 a transport endoscope having a main body and a flexible elongate shaft comprising a central axis and a plurality of channels therewithin for carrying portions of the at least one flexible elongate assembly;

a docking station configured to be detachably engaged with the transport endoscope, the docking station having a translation unit configured to matingly engage with the at least one flexible elongate assembly and selectively
10 longitudinally translate the at least one flexible elongate assembly across a predetermined distance range;

a motorbox comprising a plurality of actuators configured to drive each of the at least one flexible elongate assembly;

15 a main control unit configured to control each of the plurality of actuators according to external control signal, and a docking mechanism comprising a joint member located at the transport endoscope;

a counterpart joint member located at the docking station; and

a locking mechanism to engage the joint member with the counterpart joint
20 member;

wherein the docking mechanism is positioned to allow the transport endoscope to detach from the docking station from one of: (a) a same direction that the at least one flexible elongate assembly is matingly engaged with the translation unit, or (b) a direction parallel to the central axis of the flexible elongate shaft.

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2. The robotic endoscopy system of claim 1, further comprising,

a support function connector assembly configured to couple the main body to an external system for supporting functions including at least one of delivery of insufflation, positive pressure, suction, negative pressure, vacuum pressure, and
30 irrigation through the flexible elongate shaft of the endoscopy system.

3. The endoscopy system of claim 1, wherein at least one of the flexible elongate assemblies is an actuation assembly comprising:

a robot arm and its corresponding end effector configured to perform endoscopic procedures according to forces generated by external actuation elements;

a plurality of tendon elements configured to transmit forces generated by the external actuation elements to the robot arm and the end effector; and

an adapter configured to couple the plurality of tendon elements with the external actuation elements.

4. The endoscopy system of claim 3, wherein the motorbox comprises at least one adapter, one of the adapters of the motorbox being coupled to the adapter of the actuation assembly.

5. The endoscopy system of claim 1, wherein each of the flexible elongate assemblies further comprises a collar element configured to surround at least a portion of the flexible elongate outer sleeve at a predetermined distance away from a distal end of the end effector and configured to enable longitudinal translation of at least one of the flexible elongate assemblies across a predetermined distance range.

6. The endoscopy system of claim 5, wherein the translation unit comprises at least one receiver configured to be matingly engaged with the collar element to enable the longitudinal translation.

7. The endoscopy system of claim 3, wherein one of the flexible elongate assemblies is a flexible imaging endoscope assembly comprising:

an imaging unit configured to capture images of the end effectors of the robot arms;

a plurality of tendon elements configured for spatially positioning the imaging unit in response to applied forces; and

an adapter by which the plurality of tendon elements can be interfaced with particular external actuation elements.

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8. The robotic endoscopy system of claim 1, wherein a portion of the main body has a shape of a cuboid tube.

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9. The robotic endoscopy system of claim 1, wherein the joint member located at the transport endoscope is formed on a side surface of the main body.

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10. The robotic endoscopy system of claim 1, wherein the joint member located at the transport endoscope comprises a groove and slots; and the counterpart joint member located at the docking station comprises a protrusion and bumps, the groove and the slots for accommodating the protrusion and the bumps.

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11. The robotic endoscopy system of claim 1, wherein the joint member located at the transport endoscope comprises a clamping member to accommodate a slot of the counterpart joint member located at the docking station.

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12. The robotic endoscopy system of claim 1, wherein the locking mechanism comprises a locking lever provided on the counterpart joint member located at the docking station.

13. The robotic endoscopy system of claim 1, wherein the locking mechanism comprises release buttons provided on the counterpart joint member located at the docking station.

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14. The robotic endoscopy system of claim 1, wherein the main body further comprises a plurality of insertion inlets disposed at a proximal end of the main body, through which the plurality of channels are accessible.