

In current flexible robotic endoscopy systems, a number of flexible endoscopic instruments or instrument assemblies such as robotic arms with corresponding end effectors and an imaging assembly probe for capturing images of the end effector(s), are known. The flexible endoscopic instruments are disposable, and can be inserted  
5 into or withdrawn from the flexible robotic endoscopy system.

Within an operating theater, it is desirable to enhance or maximize the convenience and rapidity of setup/assembly and disassembly of the flexible robotic endoscopy system, while simultaneously ensuring that the overall manner in which the system is  
10 setup enables highly precise spatial and temporal control over the robotic elements of the system. Furthermore, under operating theater conditions, a clinician will need to quickly install new flexible endoscopic instruments or replace currently installed flexible endoscopic instruments with new or other types of flexible endoscopic instruments.

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Unfortunately, existing systems fail to adequately consider the impact of the manner in which the flexible endoscopic system is setup, and the manner in which flexible endoscopic instruments are inserted into and through the flexible robotic endoscopy system and the resulting forces on internal portions of the endoscopic instruments  
20 have upon the ability of the system to reliably spatially and temporally control the end effector(s) with maximum precision.

**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 of 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 of flexible elongate assemblies and to selectively longitudinally translate at least one of the flexible elongate assemblies across a predetermined distance range; (d) a motorbox comprising a plurality of actuators configured to drive each of flexible elongate assemblies; and (e) a main control unit configured to control each of the plurality of actuators according to external control signals, wherein the transport endoscope is engageable with the docking station from one of (i) the same direction as a direction from which the at least one flexible elongate assembly is matingly engaged with the translation unit, and (ii) a direction parallel to the central axis of the flexible elongate shaft.

This invention according to claim 2 has, in the robotic endoscopy system of claim 1, a characteristic in that the robotic endoscopy system further comprises 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 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 1, 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 4, 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 6, 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; 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 is a robotic endoscopy system comprising: (a) at least one flexible elongate assemblies configured to perform endoscopic procedures according to external control signal; (b) a transport endoscope comprising a proximal end, a distal end, a main body and a flexible elongate shaft, the main body comprising a housing that extends to the proximal end, a joint member on a surface of the housing and a grip toward the distal end and the flexible elongate shaft comprising a central  
10 axis and a plurality of channels therewithin for carrying portions of the at least one of flexible elongate assemblies; (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 of flexible elongate assemblies and to selectively longitudinally translate at least one of the flexible  
15 elongate assemblies across a predetermined distance range; (d) a motorbox comprising a plurality of actuators configured to drive each of flexible elongate assemblies; and (e) a main control unit configured to control each of the plurality of actuators according to external control signal.

20 This invention according to claim 9 has, in the robotic endoscopy system of claim 8, a characteristic in that portions of the housing have a shape of a cuboid tube.

This invention according to claim 10 has, in the robotic endoscopy system of claim 8, a characteristic in that the joint member is formed on a side surface of the housing.

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This invention according to claim 11 has, in the robotic endoscopy system of claim 8, a characteristic in that the housing further comprises a plurality of insertion inlets at a proximal end, through which the plurality of channels are accessible.

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**Advantageous Effects**

According to embodiments of the present disclosure, a plurality of flexible robotic elongate assemblies such as actuation assemblies and a flexible imaging endoscopy assembly can be inserted into a transport endoscope and a flexible elongate shaft thereof quickly and conveniently, in a manner that facilitates enhanced precision spatial and temporal control of the robotic elements of such assemblies.

According to embodiments of the present disclosure, the transport endoscope is easily and securely detachably engaged with the docking station, for instance, by way of the joint member. The grip on the main body of the transport endoscope is typically