numbered due to clutter) each in accordance with the present disclosure, configured to simultaneously interact with localized regions of the vessel wall 1413 upon deployment. A collection of microfingers 250a-c is shown in the process of ablating a local tissue site, thus forming an ablation zone 265. A hypothetical RF ablation current pathway 267 is shown in the figure for purposes of discussion. In a usage scenario, the microfingers 250a-e and associated sensing tips 260 may be configured to bias against the lumen wall 14 and to monitor local electrophysiological activity in the lumen wall while the surgical tool is positioned therein, and/or drawn along the axis of the lumen during a mapping process, etc. In the given example, an anatomical site 269 of interest (i.e. a nerve plexus, a high traffic nerve plexus, a tumor, etc.) is detected near to sensing tip 260, and an ablation process may be initiated through select microfingers in the arrays 250a-c. In aspects, the anatomy of interest may be mapped, and/or the layout of the anatomy determined either via movement of the microtool along the length of the lumen, via coordinated sensing, and/or stimulation/sensing between related microfinger arrays (not explicitly shown), etc. via one or more methods in accordance with the present disclosure. In aspects, two or more of the microfingers 250d-e may be configured to pass current 272 there between, to measure an electrophysiological signal there between, etc. In aspects, the system may include and/or be coupled to a controller, the controller configured to analyze the signals obtained from each microfinger and determine the location and/or state of an anatomical site of interest, determine the extent of an ablation procedure, etc.

[00183] Fig. 3 shows a plurality of micro-tips monitoring physiological response and/or stimulating local tissue during a surgical procedure. Three sensing tips 310a-c are shown abutted against a vessel wall 15. The sensing tips 310a-c may be attached to microfingers, substrates, balloons, or the like (each in accordance with the present disclosure).

[00184] In a first example 320, the first sensing tip 310a is used both to stimulate the local tissues (e.g. in order to determine proximity to a local nerve, to determine one or more aspects of local nerve function, etc.), and to ablate the local tissues (e.g. as part of a denervation event, to destroy cancerous tissue, to cauterize a tissue site, etc.). The second sensing tip 310b is configured to monitor local temperature variation of the tissues with

which it may be in contact during a surgical procedure. The third sensing tip 310c is configured to sense an electrical response from the local tissues during a surgical procedure (e.g. evoked potential, EMG, microvoltage, current flow, etc.).

[00185] Fig. 3 also shows a time series of events for the first example 320, shown during an RF ablation procedure. During a testing period 316 one or more stimulatory pulses 321~~312~~ may be applied to the first sensing tip 310a and monitored 322 by one or more of the other tips (in this case the third sensing tip 310c). Perhaps during this period the combination of stimulation and response satisfies a predetermined surgical criterion for initiating local ablation (i.e. local nerves identified, overactive neurological traffic detected, etc.). During the ablation period 317, an RF signal 323 is applied to the tissues via the first sensing tip 310a (e.g. perhaps with current flow to the third sensing tip 310c, to a remote macroelectrode, combinations thereof, etc.). The RF ablation may be performed sequentially or with a duty cycle so as to evaluate the progress throughout. It may also be performed in one sequence. The RF signal as measured by the third sensing tip 310c may be used to assist with determining bioimpedance of the local tissues, the state of the local tissues, etc. during the ablation process. In this non-limiting example, local tissue temperature 325 near to the ablation site (as monitored via the second sensing tip 310b) may also be used to estimate the extent of the ablation process, perhaps in combination with sensing via the third sensing tip 310c, and/or bioimpedance measurements. When the temperature and/or ablation process reaches a setpoint, the ablation is stopped and the local tissues are allowed to recover. This timeframe is shown as a recovery period 318. In aspects, the recovery period 318 may be less than 2min, 1min, 30s, 10s, 1s, 0.1s. In an additional testing period 319, the first sensing tip 310a may stimulate the local tissues and the third sensing tip 310c may monitor for a response. In this case, an absent response indicates that the ablation procedure has proceeded sufficiently for the intended purposes and the microsurgical sensory tip array may be advanced to a new site or removed from the lumen.

[00186] Fig. 3 also shows a time series of events for a second example 330, shown during an RF ablation procedure. In this example, the first sensing tip 310a and the third sensing tip 310c are configured so as to monitor local electrophysiological response of the tissues (i.e. to monitor extracellular neurological activity, local field potentials,

electromyographic signals, etc.) and the second sensing tip 310b is configured to apply an RF current to the lumen wall 15 adjacent there to. During a testing period 331 electrophysiological responses are monitored at the first sensing tip 310a and the third sensing tip 310c~~330c~~. As can be seen from the a-site response curve 335 and the c-site response curve 337, prior to an ablation, the coherence between the sensed signals is high (i.e. closer to 1 than to 0). During the ablation period 332 an RF signal 336 is applied to the tissues via the second sensing tip 310b (e.g. perhaps with current flow to the first sensing tip 310a, the third sensing tip 310c, or to a remote macroelectrode, combinations thereof, etc.). The RF ablation may be performed sequentially or with a duty cycle so as to evaluate the progress throughout. It may also be performed in one sequence. The associated RF signal as measured by the first sensing tip 310a and the third sensing tip 310c may be used to assist with determining bioimpedance of the local tissues, direction of RF current flow from the second sensing tip 310b, the state of the local tissues, etc. during the ablation process. When the temperature and/or ablation process reaches a setpoint, the ablation is stopped and the local tissues are allowed to recover. This timeframe is shown as a recovery period 333. In aspects, the recovery period 333 may be less than 10min, less than 5min, less than 2min, less than 1min, less than 30s, less than 10s, less than 1s, less than 0.1s, or the like. During the recovery period electrophysiological responses are monitored at the first sensing tip 310a and the third sensing tip 330c. As can be seen from the a-site response curve 335 and the c-site response curve 337, after the ablation procedure 332, the coherence between the sensed signals has changed dramatically (i.e. it has decreased significantly). The measure of coherence between the signals before and after a surgical procedure, may be a quantifiable indicator of a state of completion thereof, it may be a quantifiable measurement of the local percentage change in neurological activity, it may be an indicator of the ratio of afferent/efferent traffic in the vicinity of the sensing tips 310a-c, and the like. In this case, a markedly changed coherence between the a-site signal 335 and c-site signal 337 indicates that the ablation procedure has proceeded sufficiently for the intended purposes and the microsurgical tool in accordance with the present disclosure, may advance to a new site or removed from the lumen. Such coherence based determination of procedural outcomes may be a suitable method for automatically

performing associated surgical procedures, for controlling the extent of such surgical procedures, and the like.

[00187] Figs. 4a-b show interactions between multiple micro-tips and the local vasculature in accordance with the present disclosure. Fig. 4a shows a micro surgical tool in accordance with the present disclosure including three arrays of microfingers 410a-c interacting with the vessel walls 16 of a local anatomical site. The microfinger arrays 410a-c are shown in a deployed state from a delivery catheter 415 in accordance with the present disclosure. In aspects, the microfinger arrays 410a-c may be arranged so as to sufficiently cover the lumen walls 16 after deployment. In aspects, the microfinger arrays 410a-c may be swept along the vessel walls via torsional action of the micro surgical tool or aspect thereof. The microfinger arrays 410a-c are shown as swept in a counter clockwise direction 420 in the Fig. 4a. A local contact site between a microfinger array 410c and the vessel wall 16 is shown in more detail in blowup B. One or more of the microfingers may include one or more sensing tips in accordance with the present disclosure. Fig. 4b shows a magnified view of blowup B. Three micro-tips 430a-cb included in the microfinger array 410c are shown pressed against a local tissue site of the lumen wall 16. Each microtip includes a sensing tip 435a-c in accordance with the present disclosure. In this case, the sensing tips shown may be electrodes, MMG sensing elements, force sensing elements, temperature sensors, any sensing tip in accordance with the present disclosure, combinations thereof, or the like. A single micro-tip 430b is shown with a full outline for further discussion. During a procedure, the micro-tip 430b may be swept, oscillated, etc. the tip will interact locally with the tissue (e.g. via transverse movement, changing contact forces, etc.). Such movement may be directed towards/away from the tissue surface (i.e. in a direction normal 445 to the tissue surface), and/or along the surface of the tissue (i.e. in a direction parallel 440 to the tissue surface). Equipped with an associated deflection sensing tip and/or an interfacial pressure sensing tip, these movements may be used to elucidate local physiological properties (e.g. mechanical compliance, tone, etc.) of the tissues. Alternatively, additionally, or in combination a suitably equipped micro-tip 430b may be used to measure local mechanomyographic response, perhaps due to electrophysiological activity in the vicinity

of, or upstream from the tip 430b. Such information may be used for several intended purposes as detailed throughout this disclosure.

[00188] In aspects, the microfinger may be equipped with a needle electrode tip (perhaps formed as a structural extension of the flexure, etc.). The needle electrode tip may be configured such that upon applied torsion in a given direction, the needle may pierce the local tissues so as to enhance the electrical interface between the microfinger and the tissues. Such a needle electrode tip may be integrated into one or more microfingers and/or sensing tips in accordance with the present disclosure.

[00189] Figs. 5a-c show some non-limiting aspects of micro-tips and/or tips of one or more microfingers in accordance with the present disclosure. Fig. 5a shows schematic diagrams for the cross sections of four non-limiting examples of micro-tips in accordance with the present disclosure (i.e. in this case including one or more exposed electrode sensing tips). Fig. 5a~~4a~~ shows a schematic of the tip of a micro-finger 510 including a core flexure 512 (e.g. a superelastic spring-like material, optionally electrically conducting, a wire, a flex circuit, a micro interconnect, etc.), with an isolating layer 514 (e.g. an oxide, a dielectric coating, a radio-opaque coating, etc.) applied selectively to regions thereof. At the tip of the micro-finger 510, a region 516 of uncoated core flexure is exposed. This region 516 may, provide an electrode property for interacting with local tissues, provide a site for attachment of a microsensor, etc. In aspects, the exposed region 516 may be coated with one or more electrode materials (i.e. one or more metals, alloys, conducting polymers, composites, carbon materials, conjugated polymers, combinations thereof, or the like). In the example shown, the exposed region 516 is oriented to one side of the neutral axis of the core flexure 512. Such orientation may be advantageous for maintaining contact with an adjacent tissue surface while sweeping or moving the micro-tip 510, while biasing the micro-tip 510 against a tissue surface, etc. In aspects, the micro-tip 510 may be configured with a curvature, oriented so as to ensure the exposed region 516 will face an approaching tissue surface during deployment.

[00190] Fig. 5a shows a schematic of a micro-tip 520 in accordance with the present disclosure. The micro-tip 520 is shown with a core flexure 522 and an insulating layer 524, each in accordance with the present disclosure. The micro-tip 520 may include an

accordance with the present disclosure) including an ablation electrode 1025 is placed in contact with the tissues between the sensing sites. One or more sensing tips may be placed at the sensing sites 1010, 1015, among others, as well as optionally at the surgical site (i.e. to perform a combination of sensing and procedures). Prior to initiation of the surgical procedure, nervous activity may be detected at both sensing sites 1010, 1015. In aspects, the correlation between the electrophysiological signals (i.e. neurological signals, electromyographic signals, mechanical myographic signals, etc.) may be relatively high prior to initiation of a surgical procedure. In aspects, the correlation between the electrophysiological signals may include the step of extracting a portion of each signal that is substantially common to both signals for analysis.

[00210] Fig. 10b shows a lumen (i.e. a renal artery) after a surgical ablation process. Two sensing sites are shown, distal 1040 and proximal 1035 to the surgical site. An ablation catheter tip 1020 (e.g. although shown as a separate unit, it may be included in an associated microfinger array as a sensing tip in accordance with the present disclosure) equipped with an ablation electrode ~~1030~~ 1025 is placed in contact with the tissues between the sensing sites. The ablation catheter tip 1020 has been employed as part of a surgical procedure to form an ablation zone 1030, in this case shown substantially around the circumference of the arterial wall around the surgical site forming the ablation zone 1030. After completion of the ablation procedure, nervous activity may no longer be detected at one or more of the sensing sites 1035. In this example, the ablation procedure has substantially blocked afferent nerve traffic from proceeding through the ablation zone 1030. In aspects, efferent nerve traffic may still be detectable at the proximal sensing site 1035, and afferent nerve traffic may still be detectable at the distal sensing site 1040. The correlation between the resulting signals may be used to quantify the state of the ablation process, the extent of denervation, etc.

[00211] In aspects, the above method and variations thereof may be used to extract the afferent from the efferent nerve traffic in the vicinity of a surgical site of interest. In aspects, the surgical procedure may include the application of energy to the surgical site in a substantially low dosage so as to temporarily inhibit function of the neurological anatomy in the vicinity thereof. In one non-limiting example, the energy may be used to heat the local tissues to a temperature of greater than 40C, 45C, 50C so as to form the

[00214] In aspects, the step of evaluating the coherence between the electrophysiological signals may include the step of extracting a portion of each signal that is substantially common to both signals for analysis.

[00215] Fig. 10d shows a renal artery after a surgical ablation process. Two sensing sites are shown, distal 1065 and proximal 1060 to the surgical site and a pacing site 1070 is shown located to one side of the intended surgical site. An ablation catheter tip 1020 (e.g. although shown as a separate unit, it may be included in an associated microfinger array as a sensing tip in accordance with the present disclosure) with an ablation electrode 1025 is placed in contact with the tissues between the sensing sites 1060, 1070. The ablation catheter tip 1020 has been swept around the circumference of the arterial wall around the intended surgical site forming an ablation zone 1030. After completion of the ablation procedure, nervous activity may no longer be detected at one or more of the sensing sites 1060, 1065 even under the continued action of the pacing signal 1070.

[00216] In aspects, one or more of the distal sensing 1015, 1040, 1050, 1065, proximal sensing 1010, 1035, 1045, 1060, pacing 1055, 1070, and surgical procedure (i.e. formation of a blocked region, an ablation zone 1030, etc.) may be completed by one or more sensing tips each in accordance with the present disclosure.

[00217] Figs. 11a-gf show some non-limiting examples of ablation patterns applied to a renal artery in accordance with the present disclosure.

[00218] Fig. 11a shows a lumen 1105 (i.e. a tubule, a vessel, an artery, a vein, a renal artery, etc.) prior to the application of a surgical procedure thereto. As outlined in the Figure, a range of neurological structures (i.e. nerve plexuses) 1110, 1115, 1120, are visible within the wall and surrounding adventitia of the lumen 1105. In aspects, the lumen 1105 may provide a conduit for flow of a fluid (i.e. blood, bile, lymph, urine, feces, etc.), and to interconnect one or more organs, and or aspects of an organ (i.e. an intra-organ vessel).

[00219] Fig. 11b shows the lumen (i.e. the renal artery) with a circumferentially ablated region 1125 generated by a micro surgical tool in accordance with the present disclosure. Sensing tips located to either side or within the ablation zone 1125 may be used to confirm effective ablation, control the ablation process itself, for decision making

disclosure. In aspects, sensing tips included in the micro surgical tool may have been used to track the targeted tissues as the ablation process is occurring (so as to establish an ablation path along the target tissues), locate target tissues for ablation, monitor the ablation process itself, to avoid ablation of nerve bundles that are not to be surgically treated, to confirm effective ablation, and to limit the overall amount of damage caused by the ablation procedure. In this non-limiting example, the nerve bundle 1142 is ablated along a continuous strip 1140 as followed with guidance from the sensing tips. Such a long stretch of ablated tissue may be employed to limit the potential for regeneration after the surgical procedure has been completed. In aspects, feedback from signals obtained from one or more sensing tips may be used to guide the surgical hardware during the surgical procedure (i.e. ablation, chemical substance delivery, etc.).

[00223] Fig. 11f shows the lumen (i.e. renal artery) after selectively targeted nerve bundles 1152, 1154, 1156 have been ablated by a micro surgical tool in accordance with the present disclosure. In aspects, the sensing tips included in the micro surgical tool may have been used to locate target tissues for ablation, to identify tissues for ablation, monitor the ablation process itself, to avoid ablation of nerve bundles that are not to be surgically treated, to confirm effective ablation, and to limit the overall amount of damage caused by the ablation procedure. A substantially helical tool path 1150 is shown, as the micro surgical tool traced around the walls of the renal artery during the ablation procedure. In this non-limiting example, the nerve bundles 1152, 1154, 1156 are ablated at a plurality of local sites 1145 along the length thereof so as to limit damage to the surrounding tissues. In aspects, the targeted neuroanatomical structures 1152, 1154, 1156 may be treated along the length thereof in order to control the post-surgical regrowth rate, or the like.

[00224] Fig. 11g~~f~~ shows a lumen 1160 (i.e. a vessel, an artery, a renal artery, a vein, a tubule, etc.) after a selectively targeted treatment zones 1175, 1180, 1185 have been formed around target anatomical structures ~~1065, 1067, 1069~~ 1165, 1167, 1169 by a micro surgical tool in accordance with the present disclosure. Target neurological structure 1165, perhaps connecting one or more structures 1170 in the vicinity of the lumen 1160 to one or more external organs, ganglia, or the like, that are somewhat removed from the lumen 1160 may be targeted as well during such procedures. In aspects, sensing tips included in the

procedure. In aspects, the microfinger array 1234 may be advanced and/or retracted 1247, along the lumen 1203 and/or expanded/contracted 1249~~1238~~ as part of a procedure, a deployment, and/or a retraction procedure within the lumen 1203 during procedures related to searching for anatomical sites of interest, performing sensing, mapping, surgical treatments, ablation, or the like.

[00227] Fig. 12c shows a schematic diagram of a micro surgical tool 1250 deployed at a surgical site in accordance with the present disclosure. The micro surgical tool 1250 is shown deployed into a renal artery 1202 of a subject having passed through a superior or inferior approach (brachial or femoral arteries), via aortic artery 1205 and into the renal artery 1202 (or to the mouth thereof). The micro surgical tool 1250 includes a delivery catheter 1258 and a plurality of microfinger arrays 1252, 1254 each in accordance with the present disclosure, shown in contact with the walls of the renal artery 1203 (i.e. biased towards, in controlled contact with, penetrating into, etc.). In this, non-limiting example, the microfinger arrays 1252, 1254 are configured as a radially biased flexural springs, in accordance with the present disclosure. Such a configuration may be advantageous to maintain contact with the lumen walls during a procedure without inhibiting flow of fluids through lumen, to accommodate a wide range of anatomical features, to maintain a relatively constant bias force on the lumen walls 1203 during a procedure, for simple deployment/retraction, combinations thereof, or the like. Connected to the microfinger arrays 1252, 1254 via one or more guiding arms 1256, 1257 is a local control circuit 1260 in accordance with the present disclosure. In aspects, the guiding arm(s) 1256, 1257 may include one or more electrical interconnects, one or more structural elements, a conduit, or the like coupled to the microfinger arrays 1252, 1254 and/or the local control circuit 1260. The micro-surgical tool 1250 may also be configured to accommodate, and/or include a guide wire (not explicitly shown) configured to assist with guiding the microfinger arrays 1252, 1254 to the target anatomical site. In aspects, one or more of the guiding arms 1256, 1257 may be configured so as to retract and or advance along the microsurgical tool 1250 with respect to the microfinger arrays 1252, 1254 so as to cover and/or expose one or more of the microfinger arrays 1252, 1254 during a retraction and/or deployment process. In aspects, the control circuit 1260 may route signal traffic to and from one or more of the

[00232] Figs 15a-b show aspects of non-limiting examples of optical microsensing tips 1510 and a collective response therefrom in accordance with the present disclosure. Fig. 15a shows an array of optical microsensing tips 1510 biased towards the wall 1502~~1501~~ of a vessel. The optical microsensing tips 1510 are configured to receive from and/or emit energy into the adjacent tissues of the wall 1502~~1501~~. In aspects, an external light source 1515 may also provide light towards the surgical site (i.e. vessel walls 1502~~1501~~). In aspects, energy 1520 passing through an anatomical site of interest 1503 may be accepted by one or more of the optical microsensing tips 1510, each configured to generate a signal therefrom. In aspects, the microsensing tips 1510 may include a fiber optic element coupled to a remote light source and/or photodetector. Such a configuration may be coupled with the indicating agents described in Fig. 15 (i.e. so as to locate the target anatomy as part of a surgical procedure). In aspects, the indicating agent 1415 may be configured so as to change chromatic and/or photochemical properties in the presence, when bound to, or when incorporated into the target anatomy 1503, thus being detectable by one or more optical microsensing tips 1510.

[00233] Fig. 15b shows a spectral response of the light received by the optical microsensing tips 1510 and that emitted by an external light source. The detected signals 1535, 1540 may be used to determine the location of target tissues in the vessel wall. In aspects, the optical microsensing tips 1510 may include one or more electrode elements so as to selectively and locally ablate target tissues based on the response of the sensed signals 1535, 1540.

[00234] Fig. 16 shows a combination catheterization and endoscopic procedure on a renal artery in accordance with the present disclosure. A micro surgical tool 1610 in accordance with the present disclosure is shown as placed into the renal artery of a subject. One or more endoscopically placed light sources 1615, 1617 may be shone at the renal artery. In aspects, the light sources 1615, 1617 may be multi-band sources, broadband sources, narrow band sources, modulated, or any combination thereof. In aspects, the micro surgical 1610 tool may include one or more optical microsensors to receive such light, the processed signals used to determine the location of target tissues in the renal artery. In aspects, the microsurgical tool 1610 may include one or more sensing tips in accordance with the present disclosure to selectively treat target anatomy based on

microfinger arrays 1730a-b equipped with sensing tips 1731a-b, a guiding arm 1732, and a delivery catheter 1734 each in accordance with the present disclosure. In aspects, the guiding arm 1732, one or more microfingers 1730a-b, and/or the catheter 1734 may include a control circuit in accordance with the present disclosure. In aspects, a local control circuit 1720 in accordance with the present disclosure may be located at the operating end of the catheter 1734 (i.e outside the body of a subject during use). Alternatively, additionally, or in combination a control circuit may be coupled to one or more of the microfingers 1730a-b directly, or via the guiding arm 1732 in order to communicate signals to or from the sensing tips 1731a-b during a procedure. In aspects, the microfinger arrays 1730a-b may be configured so as to bend within the body of a subject (i.e. after a deployment process, etc.) so as to bias toward the walls of the anatomy of interest, etc. In aspects, one or more of the microfingers 1730a-b may be configured so as to bend when heated to body temperature (i.e. so as to self-deploy during a procedure). In aspects, the guiding arm 1732 and/or the catheter 1734 (and/or a sleeve thereupon) may be retracted 1736 to initiate a deployment process so as to expose one or more of the microfingers 1730a-b and bring them into contact with the intended anatomy. In aspects, one or more sensing tips 1731a-b may be equipped with one or more electrodes for electrophysiological sensing, stimulation, and/or RF current delivery to the surrounding tissues. Thus signals may be monitored between 1738 sensing tips 1731a-b in different microfinger arrays 1730a-b or within 1739 the same microfinger array 1730a, 1730b. In aspects, the guiding arm 1732 and/or catheter 1734~~1736~~ may be adjustable so as to adjust the distance between microfinger arrays 1730a-b in the micro surgical tool tip.

[00237] Fig. 17c shows a schematic diagram of aspects of a micro surgical tool in accordance with the present disclosure. The micro surgical tool includes a longitudinal wire cage including a plurality of microfingers 1740a-b, with regions coupled to sensing tips 1742a-f in accordance with the present disclosure. Such a configuration may be advantageous to maintain contact between one or more sensing tips 1742a-f with the lumen walls during a procedure without inhibiting flow of fluids through lumen. In aspects, the micro-surgical tool may be configured to accommodate, or to include a guide wire (not explicitly shown) configured to assist with guiding wire cage to the target

to locally ablate tissues. Thus both the functions of monitoring and ablation may be completed in a single sweep.

[00249] The stent-like micro tool 1862 may include any features described herein as they pertain to a microfinger in accordance with the present disclosure.

[00250] Fig. 18f shows a two dimensional graph, indicating the ablation profile of 5 sensing tips located in a stent-like micro tool in accordance with the present disclosure. The desired ablation profile may be predetermined (e.g. as determined by an initial sweep), or determined in concert during a sensing + ablation sweep. As can be seen in the example shown, two of the sensing tips did not pass any target tissue in need of ablation during this sweep, thus an ablation procedure may be directed towards other sensing tips in the array so as to minimize damage to local tissues during the procedure.

[00251] Figs. 19a-b show a tonal sensing tip and sample response in accordance with the present disclosure. Fig. 19a shows a close up of an associated microfinger 1910 in accordance with the present disclosure. The microfinger 1910 includes an interfacial pressure sensor (at the tip, in accordance with the present disclosure) and/or a flexural sensor (along the length thereof, in accordance with the present disclosure). An excitation 1915, 1920, 1925 applied to the microfinger 1910 may be used to generate variable contact forces and contact deflections at the point of contact between the microfinger and a local tissue surface 1901. Signals obtained from the flexural sensor may be representative of the contact deflections that occur during the excitation period. Signals obtained from the interfacial pressure sensor may be representative of the contact forces that occur during the excitation period. The simultaneous monitoring of both signals, perhaps in combination with a compliance model for the microfinger 1910~~1810~~ may be useful for determining the local mechanical properties of the tissue in the vicinity of the contact point.

[00252] Fig. 19b shows a deflection force curve, generated by the microfinger ~~1810~~ 1910 described in Fig. 19a during an excitation session. The deflection/force relationships (e.g. mean relationships, hysteresis, frequency dependence, creep, strain hardening, etc.) may be used to determine the type of tissues ~~1801~~ 1910 in which the microfinger is in contact. As can be seen in the figure, a particularly soft relationship 1930 (low modulus of

elasticity) may be associated with a potential tumor tissue. Healthy tissue may exhibit a modulus of elasticity within a known "good" range 1935, and the trend 1950 in elastic modulus that occurs as the tissue is ablated by a surgical procedure, may be followed to determine the extent of the ablation process. A successful ablation process may be qualified by a range of elastic modulus change 1940, as observed during the ablation process.

[00253] Figs. 20a-b show aspects of surgical tools in accordance with the present disclosure. Fig. 20a shows a surgical tool including a delivery catheter 2005 in accordance with the present disclosure including an array of microfingers 2010, the microfingers 2010 connected 2011 through the catheter 2005 to an operating fixture, control circuit, signal conditioning circuit, hand held control unit, surgical robot, a coupling, or the like. The microfingers 2010 in accordance with the present disclosure are arranged along the inside of the delivery catheter 2005 and are arranged with a pre-biased shape, such that upon retraction 2021 of the catheter 2005, the microfingers 2010 may be deployed radially ~~2019~~ 2119 towards an anatomical site of interest (i.e. a surgical site, a tissue surface, a lumen wall, etc.). One or more of the microfingers 2010 may include one or more sensing tips 2015 in accordance with the present disclosure. In the non-limiting example shown, each sensing tip includes an electrode configured to interface with an anatomical site of interest. The catheter 2005 is configured to slide over an associated guide wire 2030, so as to be easily directed to a surgical site during an insertion procedure. In the non-limiting example shown, the microfingers 2010 include shaped tips (upon which the sensing tips 2015 are arranged). Such shaped tips may be advantageous to control the bias pressure against an anatomical site of interest (i.e. so as to prevent penetration, etc.). In aspects, one or more of the microfingers 2010 may terminate at a microneedle sensing tip in accordance with the present disclosure. Such a configuration may be advantageous to allow for controlled penetration of one or more sensing tips 2015 into the wall of a surgical site. In aspects, after deployment, the entire microfinger array 2010 may be drawn 2023 along the length of a lumen, so as to map the lumen, sweep monitor and ablate the lumen, assess the state of anatomy after a surgical procedure, combinations thereof, or the like.

WHAT IS CLAIMED IS:

1. A microsurgical tool for monitoring electrophysiological activity within the vicinity of a lumen, the microsurgical tool comprising:

- a microfinger having a substantially elongate structure configured so as to bias a region thereof against a wall of the lumen upon deployment within the lumen; and
- a sensing tip electrically and mechanically coupled to the microfinger in the vicinity of the region, configured to interface with the wall of the lumen, the sensing tip configured to convey one or more electrophysiological signals associated with the activity.

2. The microsurgical tool in accordance with claim 1, wherein the electrophysiological signals are related to one or more of water concentration, tone, evoked potential, remote stimulation of nervous activity, an electromyographic signal [EMG], a mechanomyographic signal [MMG], a local field potential, an electroacoustic event, vasodialation, vessel wall stiffness, muscle sympathetic nerve activity ~~([~~[MSNA~~),~~], central sympathetic drive ~~(e.g. bursts per minute, bursts per heartbeat, etc.)~~, tissue tone, nerve traffic ~~(e.g. post ganglionic nerve traffic in the peroneal nerve, celiac ganglion, superior mesenteric ganglion, aorticorenal ganglion, renal ganglion, and/or nervous system structures).~~

3. The microsurgical tool in accordance with claim 1 or 2, wherein the sensing tip comprises one or more electrodes.

4. The microsurgical tool in accordance with any preceding claim, wherein the sensing tip is electrically coupled with a microcircuit, the microcircuit configured to condition the signal.

5. The microsurgical tool in accordance with claim 4, wherein the microcircuit is embedded into the microsurgical tool and at least a portion of the electrical coupling is provided via the microfinger.

~~6. The microsurgical tool in accordance with claim 5, wherein the microcircuit is embedded into the sensing tip or the microfinger.~~

~~7.~~6. The microsurgical tool in accordance with any preceding claim, wherein the microfinger is configured so as to substantially embed the sensing tip into the wall of the lumen.

~~8.~~7. The microsurgical tool in accordance with any preceding claim, wherein the microfinger is configured so as to substantially maintain contact with the wall of the lumen while it is swept longitudinally down the lumen and/or circumferentially around the lumen.

~~9.~~8. The microsurgical tool in accordance with any preceding claim, wherein the microfinger is configured so as to substantially maintain a constant force against the wall of the lumen during relative movement there between.

~~10. The microsurgical tool in accordance with any preceding claim, wherein the microfinger comprises an active material element, configured to alter the contact force between the region or the sensing tip, and the wall upon receipt of a control signal.~~

~~11. The microsurgical tool in accordance with claim 10 wherein the sensing tip includes a force sensor configured to measure the changing contact force~~.

~~12. The microsurgical tool in accordance with claim 11, wherein the microfinger includes a strain sensor configured to measure a strain in the microfinger.~~

~~13.~~9. The microsurgical tool in accordance with any preceding claim, wherein the microfinger is configured so as to substantially electrically isolate the sensing tip from a cavity of the lumen.

~~14. The microsurgical tool in accordance with any preceding claim, wherein the microfinger is configured so as to be deployed from a delivery catheter.~~

~~15. The microsurgical tool in accordance with claim 14 wherein at least a portion of the delivery catheter has a diameter less than 3mm, less than 2mm, less than 1mm.~~

~~16. The microsurgical tool in accordance with claim 14 wherein at least a portion of the delivery catheter has a diameter of less than 0.75mm, less than 0.5mm, less than 0.25mm so as to access a miniature lumen.~~

~~17.~~10. The microsurgical tool in accordance with any preceding claim, wherein the microfinger has a characteristic width of less than 150um, less than 100um, less than 75um, less than 50um, less than 25um, less than 10um, less than 5um.

~~18.~~11. The microsurgical tool in accordance with any preceding claim comprising a plurality of microfingers, each microfinger configured so as to substantially independently bias against the wall of the lumen upon deployment.

~~19.~~12. The microsurgical tool in accordance with claim ~~18~~11, wherein a plurality of microfingers are configured to form a cage, a mesh, or a stent-like structure.

~~20. The microsurgical tool in accordance with claim 18, wherein each microfinger is configured so as to independently maintain contact with the wall during relative movement there between.~~

~~21. The microsurgical tool in accordance with claim 18 or 20 wherein one or more sensing tips may be configured to convey signals in the presence of the relative movement.~~

~~22.~~13. The microsurgical tool in accordance with any preceding claim, wherein the sensing tip comprises a needle electrode, the microfinger configured to plunge the needle electrode into the wall of the lumen upon deployment.

~~23. The microsurgical tool in accordance with any preceding claim, wherein the sensing tip comprises a mechanomyographic (MMG) sensing element configured to generate a mechanomyographic signal (MMG) from the activity.~~

~~24. The microsurgical tool in accordance with any preceding claim, wherein the sensing tip comprises a compliance sensor, configured to generate a tissue tone signal.~~

~~25. Use of a microsurgical tool in accordance with any one of claims 1—24, to monitor electrophysiological activity in the vicinity of a vessel, an artery, a vein, or a renal artery.~~

~~26. Use of a microsurgical tool in accordance with any one of claims 1—24, to perform a surgical procedure.~~

~~27.~~14. A system for neuromodulating an anatomical site in the vicinity of a lumen, comprising:

- a subsystem configured to perform a surgical procedure on the anatomical site;
- a microsurgical tool in accordance with any preceding claim ~~one of claims 1—24~~, configured to monitor electrophysiological activity in the vicinity of the site; and
- a control unit configured to accept signals from the microsurgical tool, and to adjust the surgical procedure dependent upon the signals, to display the signals, to evaluate the surgical procedure dependent upon the signals, to plan a surgical path dependent upon the signals, and/or to determine the extent of the procedure dependent upon the signals.

~~28.~~15. The system in accordance with claim ~~27~~14, wherein the surgical procedure is selected from the group consisting of an ablation, an excision, a cut, a burn, a radio frequency ablation, radiosurgery, an ultrasonic ablation, an abrasion, a biopsy, and delivery of a substance.

~~29.~~16. The system in accordance with claim ~~27~~14 or ~~28~~15, comprising a stimulation and/or ablation electrode configured so as to convey a pulsatile and/or radio frequency signal to the anatomical site from the control unit, the microsurgical tool configured to convey one or more feedback signals related to the pulsatile and/or radio frequency signals back to the control unit.

~~30.~~17. The system in accordance with claim ~~29~~16, wherein the feedback signals are related to an electrode impedance, a bioimpedance, a local electrical field, or an electrophysiological response to the pulsatile and/or radio frequency signal.

~~31.~~18. The system in accordance with any one of claims ~~27~~14-~~30~~17, wherein the stimulation and/or ablation electrode is comprised within the microsurgical tool.

~~32.~~19. The system in accordance with claim ~~31~~18, wherein the stimulation and/or ablation electrode is comprised within the sensing tip.

~~33. The system in accordance with any one of claims 27-32, wherein the control unit is configured to sweep one or more of the sensing tips along the lumen wall.~~

~~34. The system in accordance with any one of claims 27-33, wherein the control unit is configured to use one or more of the electrophysiological signals to locate the anatomical site.~~

~~35. The system in accordance with any one of claims 27-34, wherein the control unit is configured to use one or more of the electrophysiological signals to exclude the anatomical site from a surgical procedure.~~

~~36.~~20. A method for determining an afferent electrophysiological activity and an efferent physiological activity in the vicinity of a lumen, comprising:

- monitoring electrophysiological activity at a plurality of sites within the vicinity of the lumen in regions proximal and distal to a target region as measured along a length of the lumen;
- applying energy to a site within the target region to form a neurological block thereby; and
- extracting an afferent signal from activity in the distal region and an efferent signal from activity in the proximal region.

~~37.~~21. The method in accordance with claim ~~36~~20, comprising comparing activity measured in the proximal region and the distal region to determine if the energy application affected the electrophysiological activity in the vicinity of the target region.

~~38.~~22. The method in accordance with claim ~~37~~21, comprising evaluating the coherence between activities measured in the proximal region and the distal region.

~~39.~~23. The method in accordance with claim ~~38~~22, comprising using the coherence to evaluate the extent of the neural block.

~~40.~~24. The method in accordance with any one of claims ~~36~~20 – ~~39~~23, wherein the application of energy is sufficient to form a temporary neuroblock.

~~41.~~25. The method in accordance with claim ~~40~~24, comprising comparing activities from the proximal region and the distal region during the temporary neuroblock and diagnosing a neurological condition, evaluating a neurological state, or determining if a permanent surgical procedure is required.

~~42. A method for evaluating sympathetic tone of a subject, comprising:~~

~~inserting a microsurgical tool in accordance with any one of claims 1—24 into a lumen of the subject;~~

~~recording the electrophysiological signals conveyed by the microsurgical tool;~~

~~removing the microsurgical tool from the lumen; and~~

~~generating a metric relating to sympathetic tone from the recorded signals.~~

~~43. The method in accordance with claim 42, comprising monitoring another physiological parameter remotely from the lumen to generate a corrective signal and~~

~~using the corrective signal to remove movement artifacts from the electrophysiological signals.~~

~~44. The method in accordance with one of claims 42 or 43, comprising stimulating one or more anatomical sites in the subject during the recording.~~

~~45. The method in accordance with any one of claims 42 – 44, comprising diagnosing a medical condition based at least in part upon the metric.~~

~~46. A method for monitoring and/or evaluating electrophysiological activity in the vicinity of a lumen, comprising:~~

~~– biasing an electrode against a wall of the lumen; and~~

~~– recording one or more electrophysiological signals from the activity in the vicinity of the electrode.~~

~~47. The method in accordance with claim 46, comprising recording one or more of an evoked potential, remote stimulation of nervous activity, an electromyographic signal [EMG], a mechanomyographic signal [MMG], a local field potential, an electroacoustic event, vasodialation, vessel wall stiffness, muscle sympathetic nerve activity (MSNA), central sympathetic drive (e.g. bursts per minute, bursts per heartbeat, etc.), tissue tone, nerve traffic (e.g. post ganglionic nerve traffic in the peroneal nerve, celiac ganglion, superior mesenteric ganglion, aorticorenal ganglion, renal ganglion, and/or nervous system structures) in the vicinity of the lumen.~~

~~48. The method in accordance with claim 46 or 47, comprising electrically isolating the electrode from a cavity of the lumen.~~

~~49. The method in accordance with any one of claims 46 – 48, comprising embedding the electrode into the wall of the lumen.~~

~~50. The method in accordance with any one of claims 46-49, comprising sweeping the electrode along the wall of the lumen.~~

~~51. The method in accordance with claim 50 comprising generating a map of electrophysiological activity from the recordings obtained during the sweep.~~

~~52. The method in accordance with any one of claims 46—51 comprising recording electrophysiological activity from a plurality of electrodes.~~

~~53. The method in accordance with any one of claims 46—52 comprising cancelling one or more movement artifacts from the recordings.~~

~~54. The method in accordance with any one of claims 46—53 comprising biasing a mechanomyographic (MMG) sensing element against the wall of the lumen and recording a mechanomyographic signal (MMG) from the activity.~~

~~55. A method for performing controlled neuromodulation in the vicinity of a lumen, comprising:~~

- ~~monitoring electrophysiological activity at one or more sites within the vicinity of the lumen to obtain a first activity level;~~
- ~~applying energy to a treatment site within the vicinity of the lumen;~~
- ~~monitoring electrophysiological activity at one or more sites within the vicinity of the lumen to obtain a second activity level; and~~
- ~~comparing the first activity level and the second activity level to determine if the energy application affected the electrophysiological activity, if sufficient energy was applied, or if further energy should be applied.~~

~~56. The method in accordance with claim 55 wherein the monitored electrophysiological activity comprises one or more of an evoked potential, remote~~

~~stimulation of nervous activity, an electromyographic signal [EMG], a mechanomyographic signal [MMG], a local field potential, an electroacoustic event, vasodialation, vessel wall stiffness, muscle sympathetic nerve activity (MSNA), central sympathetic drive (e.g. bursts per minute, bursts per heartbeat, etc.), tissue tone, nerve traffic (e.g. post ganglionic nerve traffic in the peroneal nerve, celiac ganglion, superior mesenteric ganglion, aorticorenal ganglion, renal ganglion, and/or nervous system structures) as measured in the vicinity of the lumen.~~

~~57. The method in accordance with claim 55 or 56, comprising determining if sufficient energy has been applied to the treatment site based on the comparison.~~

~~58. The method in accordance with any one of claims 54-57 comprising evaluating the first activity level to determine a suitable treatment site in the vicinity of the lumen.~~

~~59. The method in accordance with any one of claims 54-58 comprising mapping electrophysiological activity in the vicinity of the lumen using the first activity level.~~

~~60. The method in accordance with any one of claims 54-58 comprising applying a stimulus in the vicinity of the lumen.~~

~~61. The method in accordance with claim 60 comprising recording electrophysiological activity before, during, and/or after the stimulus.~~

~~62. The method in accordance with any one of claims 54—61 comprising recording electrophysiological activity in a proximal region and a distal region measured along the length of the lumen as spaced with respect to the treatment site, to determine if~~

~~the energy application affected the electrophysiological activity in the vicinity of the treatment site.~~

~~63. The method in accordance with any one of claims 54 – 63 comprising determining if the energy application was sufficient to form a neural block using the comparison.~~

~~64. The method in accordance with claim 63 comprising applying sufficient energy to the treatment site to form a temporary block and assessing if the change in electrophysiological activity is desirable, if so, applying sufficient energy to the treatment site so as to form a substantially irreversible block.~~

~~65. The method in accordance with any one of claims 54 – 64 wherein the energy is in the form of a radio frequency current, an ultrasonic wave, or thermal energy.~~

~~66. The method in accordance with any one of claims 54 – 65 wherein one or more of the steps is performed using a microsurgical tool in accordance with any one of claims 1 – 24.~~

~~67. A method for determining a state of a neurological connection along a neurological pathway between one or more regions in a body, comprising:~~

- ~~applying a pacing signal to a lumen in the vicinity of the neurological pathway;~~
- ~~monitoring one or more of water concentration, tone, blood oxygen saturation of local tissues, evoked potential, stimulation/sensing of nervous activity, electromyography, temperature, blood pressure, vasodialation, vessel wall stiffness, muscle sympathetic nerve activity (MSNA), central sympathetic drive (e.g. bursts per minute, bursts per~~

~~heartbeat, etc.), tissue tone, blood flow (e.g. through an artery, through a renal artery), a blood flow differential signal (e.g. a significantly abnormal and or sudden change in blood flow within a structure of the body, a vessel, an organ, etc.), blood perfusion (e.g. to an organ, an eye, etc.), a blood analyte level (e.g. a hormone concentration, norepinephrine, catecholamine, renine, angiotensin II, an ion concentration, a water level, an oxygen level, etc.), nerve traffic (e.g. post ganglionic nerve traffic in the peroneal nerve, celiac ganglion, superior mesenteric ganglion, aorticorenal ganglion, renal ganglion, and/or related nervous system structures), or combinations thereof, at one or more sites within the body to generate one or more physiological signals; and evaluating the influence of the pacing signal on the physiological signals and determining the state of neurological connection therefrom.~~

~~68. The method in accordance with claim 67, comprising applying energy in the vicinity of the lumen so as to induce a neurological block along the neurological pathway.~~

~~69. The method in accordance with claim 68, comprising pacing and monitoring before and after induction of the neurological block.~~

~~70. The method in accordance with claim 69, comprising comparing the physiological signals obtained before the neurological block to those obtained during the neurological block to determine the influence of the neurological block there upon.~~

~~71. The method in accordance with any one of claims 68 – 70, comprising determining if the neurological block is favorable in terms of treating an underlying disease state in the body.~~

~~72. The method in accordance with any one of claims 67 – 71, comprising applying energy in the vicinity of the lumen so as to induce a substantially permanent neurological block along the neurological pathway.~~

~~73. The method in accordance with any one of claims 67 – 72, comprising monitoring electrophysiological activity at a plurality of sites within the vicinity of the lumen in regions proximal and distal to the pacing site and/or to the site of a suspected or known neurological block.~~

~~74. The method in accordance with claim 73, comprising extracting an afferent signal from activity in the distal region and an efferent signal from activity in the proximal region.~~

~~75. The method in accordance with claim 74, comprising comparing activity measured in the proximal region and the distal region to determine if the energy application affected the electrophysiological activity in the vicinity of the target region.~~

~~76. Use of a method in accordance with any one of claims 67 – 75 for evaluation of the effectiveness of a neuromodulation procedure within a body.~~