CLAIMS

1. A catheter system for ablating a tissue portion of a body and visualising the ablation in real time, the system comprising:

   (i) ~~a means~~ an optical coherence tomography (OCT) system for generating an optical imaging beam;

   (ii) a catheter including a catheter tip assembly comprising:

   (a) an array of first optical fibres for carrying the optical imaging beam; and

   (b) an ablating means;

   wherein the catheter tip assembly is adapted to direct said beam onto the tissue portion and capture a reflected portion of the optical imaging beam from the tissue portion;

   (iii) a first switching means for switching the optical imaging beam between a plurality of the first optical fibres in the array; and

   (iv) a means for processing the reflected portion of the optical imaging beam to account for variations in length between the first optical fibres.

~~2. A catheter system according to claim 1 wherein the array of first optical fibres comprises at least 2-6 or 2-10 optical fibres.~~

~~3. A catheter system according to claim 2 wherein the array of first optical fibres comprises 6 optical fibres.~~

~~4. A catheter system according to any one of the preceding claims wherein the array of first optical fibres is located outside or around the ablating means.~~

~~5. A catheter system according to any one of claims 2 to 4 wherein the array of first optical fibres is arranged in a circular formation.~~

~~6. A catheter system according to any one of the preceding claims wherein at least one of the first optical fibres further comprises an optical directing component.~~

~~7. A catheter system according to claim 6 wherein half of the first optical fibres further comprise an optical directing component.~~

~~8. A catheter system according to claim 6 wherein the optical directing component is a separate component in optical communication with the first optical fibre.~~

~~9. A catheter system according to claim 6 wherein the optical directing component is provided integrally with the first optical fibre.~~

~~10. A catheter system according to claim 6 wherein the catheter tip assembly further comprises a platform member located in the catheter tip assembly and the first optical fibres terminate at apertures formed in the platform member that comprise the optical directing component.~~

2. A catheter system according claim 1 wherein the means for processing the reflected portion of the optical imaging beam to account for variations in length between the first optical fibres comprises a reference data source.

3. A catheter system according to claim 2 wherein the reference data source comprises a second array of first optical fibres for carrying the optical imaging beam.

4. A catheter system according to claim 3 wherein said means further comprises a second switching means for switching the optical imaging beam between a plurality of the first optical fibres in the second array.

5. A catheter system according to claim 2 wherein the means for processing the reflected portion of the optical imaging beam to account for variations in length between the first optical fibres comprises software including an algorithm that

calibrates the reflected portion of the optical imaging beam based on the reference data source.

6. A catheter system according to claims 4 comprising a splitter arranged to split the optical imaging beam into first beam directed to the first switching means and second beam directed to the second optical switching means.

7. A catheter system according to any one of claims 1-6 wherein the array of first optical fibres comprises at least 2-6 or 2-10 optical fibres.

~~11~~8. A catheter system according to ~~claim 6~~any one of the preceding claims wherein at least one of the first optical fibres further comprises an optical directing component and wherein the optical directing component is adapted to deflect a beam emanating from the at least one of the first optical fibre by (a) about 30º-60º; or (b) about 45º; or (c) less than or equal to 90º; and the optical directing component is a lens.

~~12. A catheter system according to claim 11 wherein the optical directing component is adapted to deflect a beam emanating from the first optical fibre by about 30º-60º.~~

~~13. A catheter system according to claim 11 wherein the optical directing component is adapted to deflect a beam emanating from the first optical fibre by about 45º.~~

~~**14.** A catheter system according to claim 6 wherein the optical directing component is a lens.~~

~~15. A catheter system according to claim 14 wherein the lens is a prism.~~

~~16. A catheter system according to claim 15 wherein the lens is cylindrical.~~

~~17. A catheter system according to claim 14 wherein the lens is a GRIN lens.~~

~~18. A catheter system according to any one of the preceding claims wherein the ablating means is located centrally relative to the array of first optical fibres.~~

~~19.~~9. A catheter system according to ~~claim 1~~any one of the preceding claims wherein the ablating means is an optical ablating ~~means~~beam carried by either one or more of the fibres in the array of first fibres together with the optical imaging beam.

10. A catheter system according to claim 9 wherein the first switching means is adapted to switch a combined beam which includes the optical imaging beam and the optical ablating beam sequentially between a plurality of the first optical fibres.

11. A catheter system according to any one of claims 1-8 wherein the ablating means is an optical ablating beam carried one or more second fibres separate to the first fibres, the one or more second fibres extending through the catheter tip assembly.

12. A catheter system according to any one of claims 1-8 wherein the ablating means comprises (a) a member heated by electricity or radio frequency waves, the catheter tip assembly and adapted to transmit heat energy form a source to the tissue portion; or (b) a radio frequency ablation electrode that extends through the catheter tip assembly.

~~20. A catheter system according to claim 19 wherein the optical ablating means comprises a second optical fibre.~~

~~21. A catheter system according to claim 20 wherein the optical ablating means comprises an array of second optical fibres.~~

~~22. A catheter system according to claim 21 wherein the array of second optical fibres comprises at least 2-4 optical fibres.~~

~~23. A catheter system according to any one of claims 19 to 22 wherein the optical ablating means further comprises an optical directing component.~~

~~24 A catheter system according to any one of claims 21 to 23 wherein 50-75% of the second optical fibres further comprise an optical directing component.~~

~~25. A catheter system according to claim 23 or 24 wherein the optical directing component is a separate component in optical communication with the optical ablating means or second optical fibre.~~

~~26. A catheter system according to claim 23 or 24 wherein the optical directing component is provided integrally with the optical ablating means or second optical fibre.~~

~~27. A catheter system according to any one of claims 23 to 26 wherein the catheter tip assembly further comprises a platform member located in the catheter tip assembly and the optical ablating means or second optical fibre terminates at aperture(s) formed in the platform member that comprises the optical directing component.~~

~~28. A catheter system according to any one of claims 23 to 27 wherein the optical directing component is adapted to deflect a beam emanating from the second optical fibre by less than or equal to 90º.~~

~~29. A catheter system according to claim 28 wherein the optical directing component is adapted to deflect a beam emanating from the second optical fibre by about 30º-60º.~~

~~30. A catheter system according to claim 11 wherein the optical directing component is adapted to deflect a beam emanating from the second optical fibre by about 45º.~~

~~31. A catheter system according to claim 24 wherein the optical directing component is a lens.~~

~~32. A catheter system according to claim 31 wherein the lens is a prism.~~

~~33. A catheter system according to claim 32 wherein the lens is cylindrical.~~

~~34. A catheter system according to claim 31 wherein the lens is a GRIN lens.~~

~~35. A catheter system according to claim 1 wherein the ablating means is a heat source.~~

~~36. A catheter system according to claim 35 wherein the heat source comprises a member heated by electricity or radio frequency waves such as high frequency alternating current.~~

~~37. A catheter system according to any one of the preceding claims wherein the first switching means is adapted to switch the optical imaging beam sequentially between a plurality of the first optical fibres.~~

~~38. A catheter system according to claim 19 wherein the first switching means is adapted to switch the optical imaging beam sequentially between a plurality of the first optical fibres and the optical ablating means.~~

~~39. A catheter system according to any one of the preceding claims wherein the means for processing the reflected portion of the optical imaging beam to account for variations in length between the first optical fibres comprises a reference data source.~~

~~40. A catheter system according to claim 39 wherein the reference data source comprises a second array of first optical fibres for carrying the optical imaging beam.~~

~~41. A catheter system according to claim 40 wherein said means further comprises a second switching means for switching the optical imaging beam between a plurality of the first optical fibres in the second array.~~

~~42. A catheter system according to claim 39 wherein the means for processing the reflected portion of the optical imaging beam to account for variations in length between the first optical fibres comprises software including an algorithm that calibrates the reflected portion of the optical imaging beam based on the reference data source.~~

~~43. A catheter system according to claim 41 wherein the second array is located outside the body.~~

~~44. A catheter system according to any one the preceding claims wherein each of the first optical fibres terminate at or adjacent to a respective aperture in the catheter tip assembly.~~

~~45. A catheter system according to claim 44 wherein each of the first optical fibres and the ablating means terminate at or adjacent to a respective aperture in the catheter tip assembly.~~

~~46. A catheter system according to claim 44 or 45 wherein the apertures comprise a glass covering.~~

~~47.~~13. A catheter system according to any one of the preceding claims wherein the catheter tip assembly further comprises one or more of (a) a sensing component; (b) electrical leads for connection to a cardiac pace maker; (c) a fluid channel of flushing system; (d) a directional control mechanism to enable remote movement control of the fibre optic catheter; (e) a means for emitting ultrasound waves; and (f) at least one magnet.

~~48. A catheter system according to claim 47 wherein the sensing component comprises a pressure sensor and/or a temperature sensor.~~

~~49. A catheter system according to any one of the preceding claims wherein the catheter tip assembly further comprises at least one magnet.~~

~~50. A catheter system according to claim 49 wherein the at least one magnet is located at or adjacent a leading end of the catheter tip assembly.~~

~~51. A catheter system according to any one of the preceding claims wherein the means for generating an optical imaging beam is an optical coherence tomography (OCT) system.~~

~~52. A catheter system according to any one of the preceding claims adapted to process the reflected portion of the optical imaging beam from the tissue portion using a frequency domain approach.~~

~~53. A catheter system according to claim 52 wherein the frequency domain approach is a swept source OCT.~~

~~54. A catheter system according to any one of claims 19-29 wherein the optical ablating means is able to generate an optical ablating beam at a selected wavelength for ablating tissue and wherein the selected wavelength is about 808-980nm.~~

~~55. A catheter system according to any one of claims 1 to 54 wherein the optical imaging means is able to generate an optical imaging beam at a selected wavelength of 700-3000nm.~~

~~56. A catheter system according to any one of claims 1 to 55 wherein the optical imaging means is able to generate an optical imaging beam at a selected wavelength of about 2000nm.~~

~~57.~~14. A method of ablating a tissue in a subject and visualising the ablation process in real time via an image of the tissue, the method comprising the steps of:

~~(i) positioning, adjacent to the tissue, a catheter tip assembly comprising:~~

~~(a) an array of first optical fibres for carrying the optical imaging beam; and~~

~~(b) an ablating means;~~

~~wherein the catheter tip assembly is adapted to direct said beam onto the tissue portion and capture a reflected portion of the optical imaging beam from the tissue portion;~~

~~(ii) actuating the ablating means and simultaneously directing said beam onto the tissue;~~

~~(iii) actuating a first switching means to switch the optical imaging beam between a plurality of the first optical fibres and capturing the optical imaging beam reflected from the tissue;~~

~~(iv) adjusting the captured optical imaging beam reflected from the tissue to account for variations in length between the first optical fibres; and~~

~~(v) using the adjusted captured optical imaging beam from step (iv) to create the image of the tissue.~~

(i) generating an optical imaging beam using an optical coherence tomography (OCT) system

(ii) switching the optical imaging beam through a first array of a plurality of first optical fibres carried in a catheter tip assembly to illuminate a portion of tissue and capturing a reflected imaging beam being reflected from the portion of tissue beam;

(iii) switching the optical imaging beam through a second array of the first optical fibres and using data generated from the second array to facilitate adjustment of the reflect image beam to account for variations in length of fibres in the first array;

(iv) using the adjusted reflected image beam from step (iv) and the OCT system to create the image of the tissue;

(v) directing an ablation beam through the catheter tip assembly to ablate a portion of tissue imaged by the OCT system.