CLAIMS

1. An apparatus for treating or preventing a valvular disease, said apparatus comprising:

- a ultrasound probe (2,6) located externally to a heart (H) of patient (P), able to produce ultrasound waves focused inside said heart and suitable to generate, at a focal spot, a pressure sufficient to result in cavitation,
- an imaging device (4) for mapping in real time a treatment region (A, C) of a cardiac valve of the patient, said treatment region comprising at least one leaflet of the cardiac valve,
- a controller (5, 7, 8) configured for driving the ultrasound probe to emit a sequence of focused ultrasound waves,
- a measuring device suitable for measuring an index of valvular stenosis after having controlled the ultrasound probe to emit the sequence of *N* focused ultrasound waves,

the controller being further configured for estimating in real-time a motion of the treatment region from images acquired by said imaging device, and for steering the focused ultrasound waves emitted by the ultrasound probe in function of said motion of the treatment region to scan the entire treatment region, and

the controller being further configured for reiterating the steps of controlling the ultrasound probe to emit a sequence of focused ultrasound waves and measuring said index of valvular stenosis until said index crosses a predefined threshold.

2. The apparatus according to claim 1, further comprising a robotic arm (3) carrying said ultrasound probe, the controller being configured for driving the robotic harm to control the location of the ultrasound probe externally to the heart of the patient so as to keep the treatment region inside a scannable region of the ultrasound probe.

3. The apparatus according to claim 1, wherein said measuring device is a Doppler imager configured for measuring a hemodynamic parameter, said index of valvular stenosis being a function of said hemodynamic parameter.

4. The apparatus according to claim 1, wherein said measuring device is an imaging device configured for detecting and estimating a valve motion parameter, said index of valvular stenosis being a function of said valve motion parameter.

5. The apparatus according to claim 1, wherein said measuring device is a shear wave imager configured for measuring a shear wave propagation parameter, said index of valvular stenosis being a function of said shear wave propagation parameter.

6. The apparatus according to any of the preceding claims, wherein the controller is configured for driving the ultrasound probe to emit said sequence of focused ultrasound waves at a rate between 20 and 5000 shots per seconds.

7. The apparatus according to any of the preceding claims, wherein the controller is configured for steering

the focused ultrasound waves so as to move their focal spot at a travelling speed comprised between 0.1 mm/s and 10 mm/s.

8. The apparatus according to any of the preceding claims, wherein the controller is configured for steering the focused ultrasound waves in such a way that a point of the treatment region is included in the focal spots of a number *M* of focused ultrasound waves of the sequence of focused ultrasound waves, said number *M* being comprised between 1 and 1000, preferably between 2 and 1000, even more preferably between 15 and 150.

9. The apparatus according to any of the preceding claims, wherein the controller is configured for steering the focused ultrasound waves in such a way that the focal spots of the sequence of focused ultrasound waves are separated from one another by a minimal distance larger than 0.1 millimetres.

10. The apparatus according to any of the preceding claims, wherein the controller is configured for driving the ultrasound probe in such a way that a duration of a pressure pulse generated by each focused ultrasound wave of the sequence of focused ultrasound waves is less than 80 microseconds, preferably less than 20 microseconds.

11. The apparatus according to any of the preceding claims, wherein the ultrasound probe comprises a plurality of transducers (6) within a reflective cavity (9), and wherein the controller is configured for driving at least one said transducer to emit an emission signal in the reflective cavity, the duration of said emission signal

being less than 10 milliseconds, preferably less than 1 millisecond.

12. The apparatus according to claim 11, wherein the duration of the emission signal emitted by said at least one transducer to generate said focused ultrasound wave is at least ten times longer than the duration of a pressure pulse generated by said focused ultrasound wave at a focal spot, preferably at least hundred times longer than said duration of said pressure pulse.

13. The apparatus according to any of the preceding claims, wherein the controller is configured for driving the ultrasound probe for emitting said focused ultrasound waves such that each of them generates at a focal spot a peak negative pressure half-cycle that exceeds a peak negative pressure of 5 MPa and/or a peak positive pressure half-cycle that exceeds a peak positive pressure of 10 MPa.

14. The apparatus according to any of the preceding claims, wherein the controller is further configured for receiving an electrocadiography signal and for driving the ultrasound probe to emit the sequence of focused ultrasound waves during specific moments in a cardiac cycle, determined from said electrocardiography signal.