CLAIMS

[Claim 1] A real-time image processing method comprising:

(a) generating, with a digital camera, a video feed of a bladder wall;

(b) establishing, with a processor, virtual markers on the bladder wall in the video feed, wherein establishing the virtual markers comprises:

(1) locating in a first frame of the video feed, with the processor, a natural feature of the bladder wall;

(2) assigning, with the processor, a first set of virtual markers to the natural feature in the first frame;

(3) locating in a second frame of the video feed, with the processor, the natural feature on the bladder wall; and

(4) assigning, with the processor, a second set of virtual markers to the natural feature in the second frame;

(c) tracking, with the processor, relative movements between the virtual markers of the first set of virtual markers and the second set of virtual markers, wherein tracking the relative movements comprises:

(1) establishing, with the processor, a tracking area of the bladder wall in the first frame and the second frame that includes the first set of virtual markers and the second set of virtual markers;

(2) analyzing, with the processor, relative movements between the first set of virtual markers and the second set of virtual markers in the tracking area to determine one or more movement vectors;

(3) determining, with the processor, for each of the one or more movement vectors:

(i) a center of movement for the movement vector in the tracking area;

(ii) a magnitude of the movement vector and a distance from the center of movement for the movement vector; and

(iii) a ratio of the magnitude of the movement vector to the distance from the center of movement for the movement vector;

(4) qualifying, with the processor, the contraction as a qualified contraction of the bladder wall when the ratio is parabolic;

(5) identifying, with the processor, a location of the qualified contraction of the bladder wall based on the relative movements; and

(6) calculating characteristics of the qualified contraction, the characteristics including at least one a contraction strength, a contraction frequency, a contraction profile, a contraction duration, and a contraction density;

(d) overlaying, with the processor, the location of the qualified contraction and at least one indicator of the qualified contraction onto the video feed, wherein the at least one indicator includes at least one of the characteristics of the qualified contraction; and

(e) outputting in real-time, with the processor, the video feed to a display device.

[Claim 2] The method of claim 1, further comprising positioning the digital camera adjacent the bladder wall.

[Claim 3] The method of claim 2, further comprising positioning the digital camera adjacent an interior surface of the bladder wall.

[Claim 4] The method of claim 1, wherein:

(a) establishing the virtual markers further comprises generating, with the processor, a first binary image of the first frame and a second binary image of the second frame;

(b) each of the first and second binary images including data points defining a synthetic geometry of the natural feature; and

(c) the locating and assigning steps further comprise:

(1) locating in the first and second binary images, with the processor, the location of the natural feature by generating a correlation between a reference pattern and data points from the synthetic geometry; and

(2) assigning, with the processor, the first and second virtual markers to the data points based on the correlation.

[Claim 5] The method of claim 4, wherein the reference pattern includes a X or Y shape corresponding with a blood vessel bifurcation.

[Claim 6] The method of claim 1, further comprising:

monitoring, with a sensor, characteristics of the bladder wall including at least one of a fluid pressure applied to the bladder wall and a volume of fluid retained by the bladder wall; and

generating, with the processor, a correlation between the characteristics of the contraction and the characteristics of the bladder.