Claims

1. An apparatus for monitoring positions on an external object provided with at least one beacon (1(i), i = 1, 2, …, I), the apparatus comprising:
An image sensor (11);
A lens system (13) for projecting light on said image sensor (11);
A processing unit (9);
Said processing unit (9) being arranged such as to allow communication with a memory (15) storing a computer program comprising instructions and data, which computer program can be run by the processing unit (9);
Said lens system (13) being arranged to receive at least one light beam (5(i)) transmitted from said at least one beacon (1(i)) and transfer said at least one light beam (5(i)) to said image sensor (11);
Said image sensor (11) being arranged to form image data based on said received at least one light beam (5(i)); and
Said processing unit (9) being arranged to
    - capture a series of sequential images, each image substantially being a two-dimensional array of light values;
    - correlate the sequence of images with one or more predetermined patterns stored in said memory (15), thereby producing one or more two-dimensional correlation matrices; and
    - identify, based on image processing of said one or more two-dimensional correlation matrices, said at least one beacon (1(i)) within the image data based on a light signature of the at least one light beam (5(i)),
    - determine current location data of said at least one beacon (1(i)) based on the one or more two-dimensional correlation matrices,
    - compare said current location data with former location data of said one or more beacons (1(i)) as stored in said memory (15) and
    - determine whether said object has moved relative to a fixed reference frame based on said comparison.

2. The apparatus according to claim 1, wherein the processing unit is further arranged to calculate said current location data by calculating positions and solid vectors using subpixel resolution, wherein subpixel resolution of the current location data is computed by determining a center of gravity of each beacon image.

3. The apparatus according to any one of the preceding claims, wherein the lens system (13) comprises an out of focus lens system or an aperture for creating diffraction.

4. The apparatus according to any one of the preceding claims, wherein the fixed reference frame is defined relative to the earth.

5. The apparatus according to any of the preceding claims , wherein the processing unit (9) is arranged to determine light intensity and/or wavelength of said at least one light beam (5(i)) based on said image data, and to derive additional data as transmitted by said at least one beacon (1(i)) which modulated said light intensity and/or wavelength.

6. The apparatus according to claim 5, wherein said lens system (13) is arranged to receive a consecutive series of light beams (5(i)) transmitted from said at least one external beacon (1(i)) and transfer said consecutive light beams (5(i)) to said image sensor (11); said image sensor (11) is arranged to form consecutive pieces of image data based on said received consecutive light beams (5(i)); and said processing unit is arranged to determine consecutive light intensities and/or wavelength of said consecutive light beams (5(i)) based on said consecutive pieces of image data, and to demodulate said consecutive light intensities and/or wavelength to derive said additional data.

7. The apparatus according to claim 6, wherein said consecutive light intensities and/or wavelength are modulated by one of amplitude modulation, frequency modulation, and phase modulation.

8. The apparatus according to any of the preceding claims, wherein the apparatus comprises a light generating system (21) connected to the processing unit (9), the processing unit (9) being arranged to control said light generating system (21) to generate and transmit at least one outgoing light beam (6(i)) with a modulated light intensity and/or wavelength such as to contain outgoing additional data.

9. Method of monitoring positions on an object provided with at least one beacon (1(i), i = 1, 2, …, I), the method comprising:

- receiving at least one light beam (5(i)) transmitted from said at least one beacon (1(i)); forming image data based on said received at least one light beam (5(i));
- wherein said forming image data comprises capturing a series of sequential images, each image substantially being a two-dimensional array of light values;
- correlating the sequence of images with one or more predetermined patterns stored in said memory, thereby producing one or more two-dimensional correlation matrices; and
- identifying, based on the one or more two-dimensional correlation matrices, said at least one beacon (1(i)) within the image data based on a light signature of at least one light beam (5(i)) received from at least one beacon (1(i)),
- determining current location data of said at least one beacon (1(i)) based on the one or more two-dimensional correlation matrices,
- comparing said current location data with former location data of said one or more beacons (1(i)) and
- determining whether said object has moved relative to a fixed reference frame based on said comparison.

10. Method according to claim 9, further comprising calculating said current location data by calculating positions and solid vectors using subpixel resolution, wherein the subpixel resolution of the current location data is computed by determining a center of gravity of each beacon image.