Claims

1. A device for determining a density of a fluid, the device comprising
   - a mechanical resonator,
   - a driver/receiver unit arranged to provide an actuation to the mechanical resonator, sense a response of the mechanical resonator to the actuation, and provide an output signal representing the response, and
   - an evaluation unit for determining a resonance frequency of the mechanical resonator based on the output signal of the driver/receiver unit,

   characterized in that

   the evaluation unit being arranged to:
   - determine an oscillation distribution from the output signal,
   - determine a resonance frequency estimate from the oscillation distribution, and
   - determine the density of the fluid based upon the resonance frequency estimate.

2. The device according to claim 1 wherein the evaluation unit comprises a computational unit for:
   - determining the resonance frequency estimate from the oscillation distribution, and
   - determine the density of the fluid based upon the resonance frequency estimate.

3. The device according to claim 2 wherein the evaluation unit comprises a measurement unit for determining an oscillation distribution from the output signal.

4. The device according to claim 3 wherein the output signal represents a sampling of the response of the resonator.

5. The device according to claim 2 wherein the computational unit is arranged to apply a Fourrier transformation for determining the resonance frequency estimate from the oscillation distribution.

6. The device according to claim 2 - 3 wherein the oscillation distribution comprises an oscillation period distribution derived from the output signal.

7. The device according to claim 6 wherein the oscillation period distribution comprises an array of oscillation period values derived from the output signal by determining a duration of a plurality of subsequent oscillation periods of the output signal and storing a value representing the duration in the array.

8. The device according to any of the claims 2-7 wherein the computational unit is further arranged to determine a resonance peak value from the oscillation distribution.

9. The device according to any of the claims 2-8 wherein the computational unit is arranged to determine at least two resonance peak values from the oscillation distribution using a polyfunctional probability density distribution curve.

10. The device according to any preceding claim further comprising a display for displaying the oscillation distribution.

11. The device according to any of the claims 2 – 10 wherein the computational unit comprises a microprocessor for
    - determining the resonance frequency estimate from the oscillation distribution and
    - determining the density of the fluid based upon the resonance frequency estimate.

12. The device according to any preceding claim wherein :
    the oscillation period of the mechanical resonator is within the range of 0.1 – 1.0 ms.

13. The device according to any of the claims 2 – 10 wherein :
    the computational unit is arranged to determine a mean value of the oscillation period of the mechanical resonator.

14. The device according to any preceding claim further comprising:
    a sensor such as a temperature sensor or a pressure sensor for measuring a characteristic of the fluid or the mechanical resonator.

15. The device according to any preceding claim wherein the driver/receiver unit comprises an electromagnetic actuator or a piezo-electric actuator for providing the actuation to the mechanical resonator.

16. The device according to any preceding claim wherein the driver/receiver unit further comprises a piezo-electric sensor for sensing the response of the mechanical resonator to the actuation.

17. The device according to any preceding claim wherein the mechanical resonator comprises a tuning fork, or a rod, or a T-shaped resonator having a basis mounted to the driver/receiver unit.

Claims

1. A device for determining a density of a fluid, the device comprising
   - a mechanical resonator (100),
   - a driver/receiver unit (110) arranged to provide an actuation to the mechanical resonator (100), sense a response of the mechanical resonator (100) to the actuation, and provide an output signal representing the response, and
   - an evaluation unit (120) for determining a resonance frequency of the mechanical resonator (100) based on the output signal of the driver/receiver unit (110), **characterized in that**

   the evaluation unit (120) being arranged to
   i. determine an oscillation distribution from the output signal,
   ii. determine a resonance frequency estimate from the oscillation distribution, and
   iii. determine the density of the fluid based upon the resonance frequency estimate.

2. The device according to claim 1 wherein the evaluation unit (120) comprises a computational unit (14) for:
   iv. determining the resonance frequency estimate from the oscillation distribution, and
   v. determine the density of the fluid based upon the resonance frequency estimate.

3. The device according to claim 2 wherein the evaluation unit (120) comprises a measurement unit (13) for determining an oscillation distribution from the output signal.

4. The device according to claim 3 wherein the output signal represents a sampling of the response of the resonator (100).

5. The device according to claim 2 wherein the computational unit is arranged to apply a Fourrier transformation for determining the resonance frequency estimate from the oscillation distribution.

6. The device according to claim 2 - 3 wherein the oscillation distribution comprises an oscillation period distribution derived from the output signal.

7. The device according to claim 6 wherein the oscillation period distribution comprises an array of oscillation period values derived from the output signal by determining a duration of a plurality of subsequent oscillation periods of the output signal and storing a value representing the duration in the array.

8. The device according to any of the claims 2-7 wherein the computational unit is further arranged to determine a resonance peak value (T1, T2) from the oscillation distribution.

9. The device according to any of the claims 2-8 wherein the computational unit (14) is arranged to determine at least two resonance peak values (T1, T2) from the oscillation distribution using a polyfunctional probability density distribution curve.

10. The device according to any preceding claim further comprising a display for displaying the oscillation distribution.

11. The device according to any of the claims 2 – 10 wherein the computational unit (14) comprises a microprocessor for

    vi. determining the resonance frequency from the oscillation distribution.
    vii. determine the density of the fluid based upon the resonance frequency.

12. The device according to any preceding claim wherein :
the oscillation period of the mechanical resonator (100) is within the range of 0.1 – 1.0 ms.

13. The device according to any of the claims 2 – 10 wherein :
the computational unit is arranged to determine a mean value of the oscillation period of the mechanical resonator (100).

14. The device according to any preceding claim further comprising:
a sensor such as a temperature sensor or a pressure sensor for measuring a characteristic of the fluid or the mechanical resonator.

15. The device according to any preceding claim wherein the driver/receiver unit comprises an electromagnetic actuator or a piezo-electric actuator for providing the actuation to the mechanical resonator.

16. The device according to any preceding claim wherein the driver/receiver unit (110) further comprises a piezo-electric sensor for sensing the response of the mechanical resonator to the actuation.

17. The device according to any preceding claim wherein the mechanical resonator (100) comprises a tuning fork, or a rod, or a T-shaped resonator having a basis mounted to the driver/receiver unit (110).