

水晶振動子を用いた超高感度・超ワイドレンジ荷重センサ

室崎裕一¹ 市川明彦¹ 新井史人¹



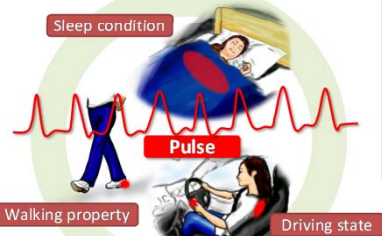
NAGOYA UNIVERSITY

¹名古屋大学大学院工学研究科マイクロ・ナノシステム工学専攻

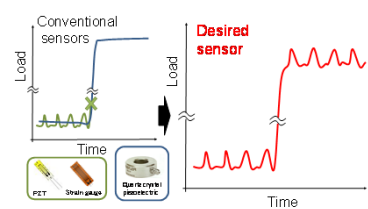


10⁴オーダーの計測レンジを有する荷重センサの小型化・高感度化

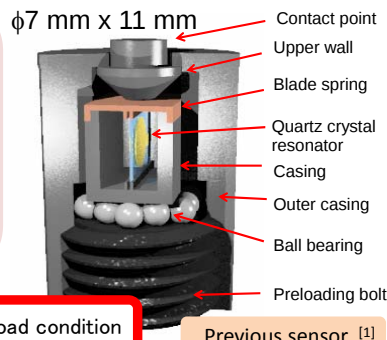
Background



To detect biological signals



Need to measure small load under the high-load condition



Requirements

- High sensitivity
- Wide range
- Small size

Quartz Crystal Resonator (QCR)

Purpose

For the detection of biological signals

- Increase sensitivity
- Miniaturization

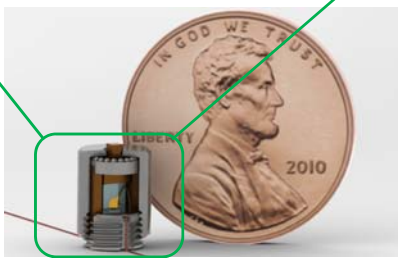
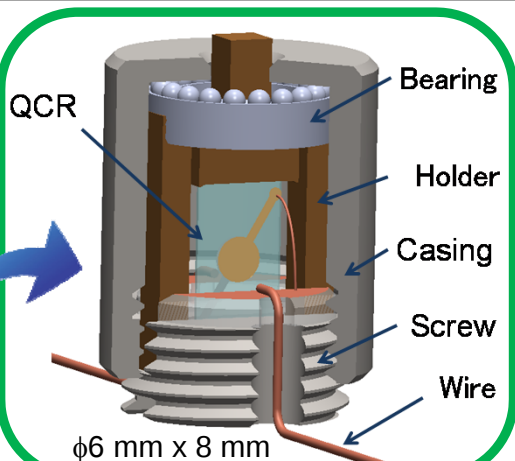
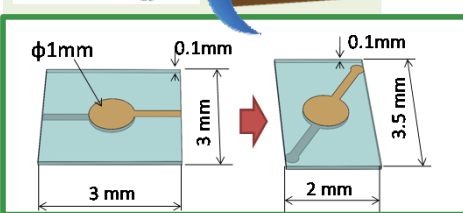
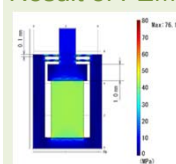
Concept

- Improvement of sensitivity
⇒ Change the shape of QCR
High force transmission efficiency

- Miniaturization
⇒ Unification of holder

- Additionally
- Wire relay point
 - Preloading mechanism

Result of FEM



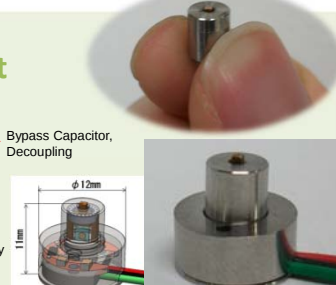
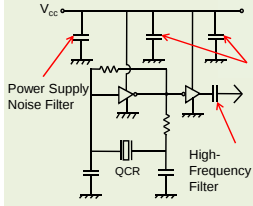
Fabrication

Fabrication process of QCR

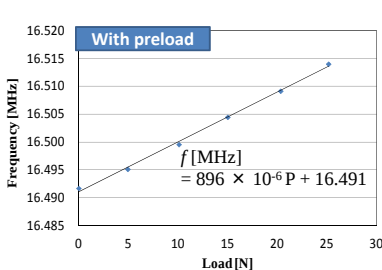
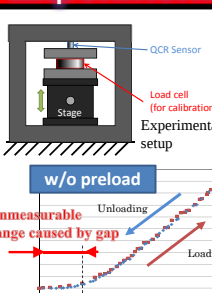
- (1) Coat resists
- (2) Expose
- (3) Develop
- (4) Sputter Cr&Au
- (5) Remove sacrificial layer
- (6) Flip & Repeat (1)~(5)
- (7) Dice



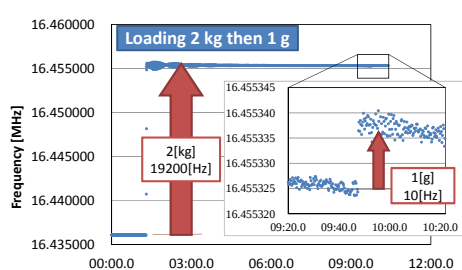
Integration of oscillation circuit



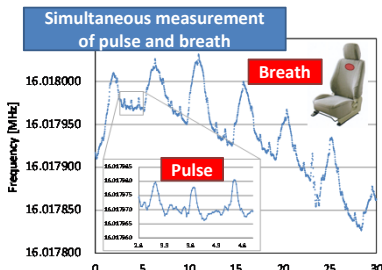
Experiment



- High linearity
- Sensitivity: 573 Hz/N^[1] ⇒ 896 Hz/N



High sensitive and wide-range measurement



Successfully detected pulse and breath signals simultaneously

Conclusion

1. Sensor sensitivity was increased from 574 Hz/N^[1] to 896 Hz/N
2. Sensor volume was reduced from 423mm³ to 226mm³ (Volume ratio 53%)
3. Pulse and breath signals were successfully detected simultaneously

Reference

[1] K. Narumi, T. Fukuda, F. Arai, Miniaturization and resolution improvement of load sensor using AT-cut quartz crystal resonator, Proc. of IEEE/SICE International Symposium on System Integration 2009, pp13-18, Jan. 2009

本研究に関するお問い合わせ先: 室崎 裕一 (Yuichi Murozaki)

E-mail: murozaki@mech.nagoya-u.ac.jp,

URL: <http://www.biorobotics.mech.nagoya-u.ac.jp/>

〒464-8603 名古屋市千種区不老町

名古屋大学大学院工学研究科 マイクロ・ナノシステム工学専攻 新井研究室

TEL: 052-789-5026, FAX: 052-789-5027

[Reference] Y. Murozaki et al., The Robotics and Mechatronics Conference, 2A2-A11, 2013 in Tsukuba

