

# SMART BOLT FOR DIGITAL BOLTED JOINT MONITORING SYSTEM

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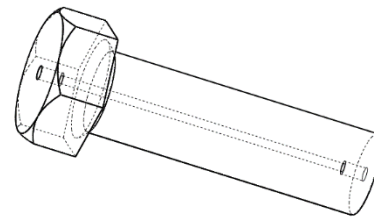
## Product Background

- Bolted joints are critical for the safe operation in pipeline system. Previous embedded strain gauge smart bolt had been served well for a long time. However, strain gauge has disadvantages of massive cabling, prone to electromagnetic interference and harsh condition especially underwater application. Therefore, an embedded fiber Bragg grating (FBG) smart bolt has been proposed.



Embedded strain gauge smart bolt

## State of the Art/ Methods



3D model design



Cross sectional view

## Product Image and Product Characteristics



Embedded FBG smart bolt

## Marketability & Commercialisation

The potential users:

- Water supply provider (e.g. Jabatan Bekalan Air)
- All industrial and chemical plants (e.g. Petronas Chemical Group Berhad)
- Oil and gas pipelines (e.g. Petronas and Shell vendors)

## Benefits/Usefulness/ Applicability



Example of product usage for bolted flange monitoring

## Novelty/ Originality/ Inventiveness

	Existing product	Proposed product
1	Commonly used strain gauge which required massive cables for multi-sensing	Only use one cable for multi-sensing
2	Prone to electromagnetic interference	Immune to electromagnetic interference
3	Electrical based sensor – short circuit occur when exposed to water	Optical based sensor – suitable for underwater application
4	Not suitable for high temperature	Can withstand high temperature up to 600 °C
5	Electrical spark could cause explosion	No electrical spark

## Cost Analysis

- Machining and fabrication cost: RM 80 per bolt

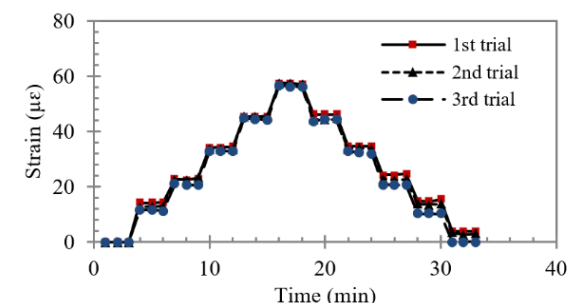
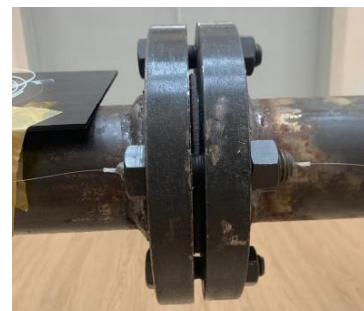
## Related publications

- Temperature-independent chirped FBG pressure transducer with high sensitivity. *Optics and Lasers in Engineering*, 117, 49-56, 2019. (ISI, Q1, IF=4.059)
- FBG Water-Level Transducer Based on PVC-Cantilever and Rubber-Diaphragm Structure. *IEEE Sensors Journal*, 19(17), 7407-7414, 2019. (ISI, Q1, IF=3.076)
- A highly sensitive multiplexed FBG pressure transducer based on natural rubber diaphragm and ultrathin aluminium sheet. *Optics & Laser Technology*, 106, 177-181, 2018. (ISI, Q1, IF=3.319)
- Temperature-insensitive pressure transducer based on reflected broadened spectrum with enhanced sensitivity. *Sensors and Actuators A: Physical*, 288, 61-66, 2019. (ISI, Q2, IF=2.739)

## Status of Innovation

TRL Level 4

This product has been tested in different similar environment in industry. Relevant stakeholders have been identified (eg: TMM Engineering Services Sdn Bhd)



## Related achievements / Awards

Title: A Pressure Transducer

- Creation, Innovation, Technology & Research Exposition (CITREX) 2018 – Top 10 Gold medal
- International Invention, Innovation and Technology Exhibition (ITEX) 2018 – Gold medal

Title: Online Impact Damage Monitoring System for Real-Time Structural Health Monitoring

- Advanced Innovation & Engineering Exhibition (AiNEX) 2016 – Gold medal with best awards
- Creation, Innovation, Technology & Research Exposition (CITREx) 2017 – Gold medal

## Collaborations / Industrial Partners



KEMENTERIAN  
PENGAJIAN TINGGI



UMP TECHNOLOGY  
SDN BHD



PHOTONICS  
RESEARCH CENTRE,  
UMP

## Interested Companies



TMM ENGINEERING  
SERVICES SDN BHD



FULL STAR  
CONSTRUCTION  
SDN BHD



UNIVERSITI  
TEKNOLOGI  
PETRONAS (UTP)