



A deformable micropatterned polymer sheet for a CatWalk automated quantitative gait-force analysis system in walking mice

Sangyun Park¹, Hyoungseon Choi¹, Jiwon Ryu¹ and Hee Chan Kim^{2,3*}

1. Interdisciplinary Program, Bioengineering Major, Graduate School, Seoul National University
 2. Department of Biomedical Engineering, College of Medicine, Seoul National University
 3. Institute of Medical & Biological Engineering, Medical Research Center, Seoul National University

I. Introduction

- Gait analysis
 - Effective method for studying animal models
 - Pain analysis
 - Evaluating nervous system damage
- CatWalk method
 - One of the most effective gait analysis tool
 - Optical recording
 - Excellent spatial resolution
- Drawback of CatWalk method
 - Quantitative paw pressure measurement is not affordable
 - Optical signal from paw pressing is highly dependent on microstructure and characteristic of paw surface
- Paw pressure quantification
 - Polymer sheet between optical waveguide and pressing paw
 - Normalizing microstructure characteristic between animal paw and waveguide
 - Microstructured polymer sheet faithfully transduces paw pressure

II. Experiments

A. Experimental Setup

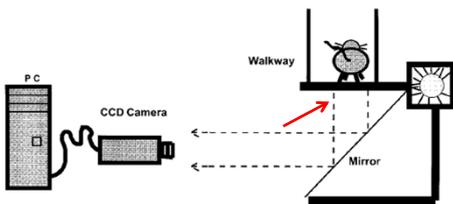


Figure 1. Conventional CatWalk system. Micropatterned polymer sheet is placed onto the glass floor in proposed method (red arrow).

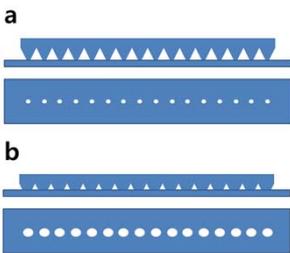


Figure 2. Schematic description of the proposed polymer sheet. When the pressure is small, optical output signal is small (a). As the pressure gets bigger, optical output signal gets bigger.

- Light Source
 - 12V drive LED array
- Micropatterned polymer sheet
 - Electrospun PMMA nanofiber sheet
 - Fiber thickness: 500nm~1um

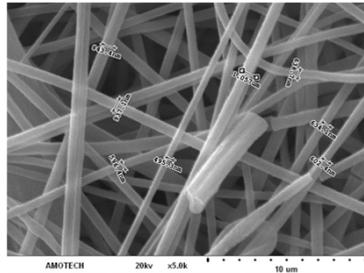


Figure 3. Scanning Electron Microscopic Image of electrospun PMMA sheet

- Light Waveguide Floor
 - 5mm thick glass plate
- Image recorder
 - Sony HDD HD Camcorder



Figure 4. Picture of modified CatWalk setup. Polymer sheet in this picture is PDMS sheet instead of electrospun nanofiber sheet used for experiments.

III. Results

A. Mouse footprint image

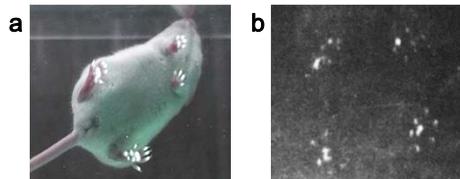


Figure 5. Footprint image acquired by conventional (a) and proposed (b) CatWalk instrument. Because of the polymer sheet between animal and floor, only the footprints are visible in the image of proposed method

B. Phantom study

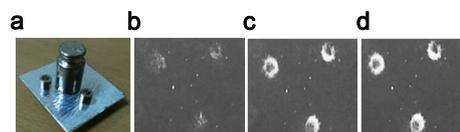


Figure 6. Tripod phantom with a balance weight on the center (a). Footprint image acquired by 2.15 g (b), 12.15 g (c), 22.15 g (d) weight. Footprint intensity gets brighter as the tripod gets heavier.

C. Calibration Curve

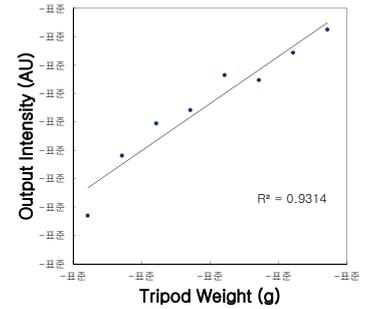


Figure 7. Correlation between tripod weight and output intensity. R square is reasonably high.

- Averaged intensity of one footprint of tripod image in red channel
- Calibration Equation
- $Y \text{ (AU)} = 0.4986 X \text{ (g/cm}^2\text{)} + 61.601$

IV. Conclusion

- Gait analysis system adopting CatWalk method was presented.
- Modifying conventional CatWalk system was done by adopting microstructured polymer sheet
- Electrospun PMMA nanofiber sheet was applied as pressure transducer
- System was found to be feasible with real mouse test
- Phantom study was done using various weighted tripod and calibration equation was achieved

V. References

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