

Design process of innovative cycling gloves

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The aim of this work is to create the basis for the development of innovative cycling gloves that reduce vibrations acting on the hand-arm system of cyclists. Indeed, hand-arm vibrations (HAV) can cause various injuries and disorders.

UNDERSTANDING THE OPPORTUNITY

A population of 15 recreational cyclists was asked to participate in a survey consisting of the following main sections:

1. **population definition;**
2. **semantic domain exploration** (Kansei Engineering [1]);
3. **characteristics domain exploration** (Kano analysis [2]).

CONCEPT GENERATION

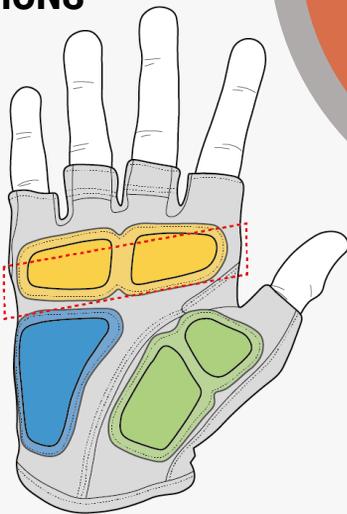
Optimal glove concept:

- ✓ **reflective details;**
- ✓ **no inner seams;**
- ✓ **vibration reduction;**
- ✓ **padding;**
- ✓ **reduced thickness.**



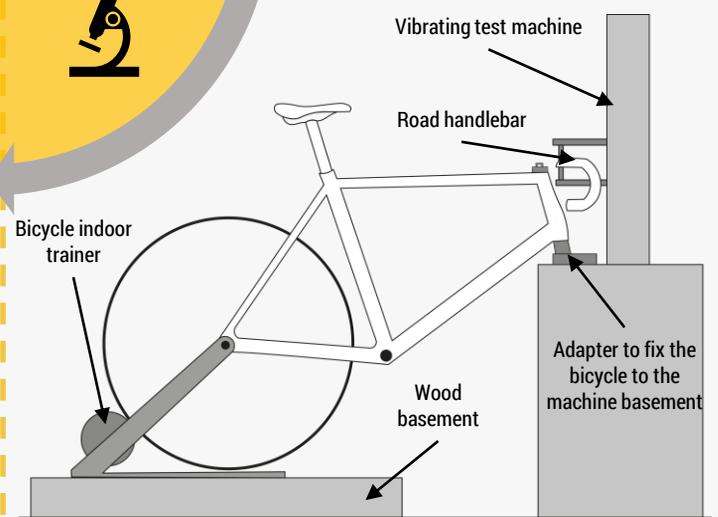
The simultaneous presence of these features leads to a conflict. To overcome it, TRIZ method should be used.

CONCLUSIONS



- Cycling gloves currently on the market **do not attenuate vibrations** in the position used for the tests (drops riding position), in which only the area circled in red touches the handlebar.
- When developing innovative cycling gloves, special attention should be paid to **reducing vibrations**. The **user experience** will guide the next design phase.

TEST PHASE



Laboratory tests [3] were conducted to understand the **effect of HAV on cycling gloves currently on the market**.

The Design of Experiments was used to plan the tests:

- 3 control factors with 3 levels each (complete test plan of $3^3 = 27$ trials);
- **6 subjects** (5 male, 1 female);
- **5 replications** for each test condition.

FURTHER TESTS
(different positions on the handlebar)

INNOVATIVE GLOVES CONCEPT GENERATION

Submit renderings and mock-ups for cyclists to reach the **OPTIMAL CONCEPT**

PRODUCE A PROTOTYPE of the optimal concept to be tested



[1] Lanzotti, A., Tarantino, P.: Kansei engineering approach for total quality design and continuous innovation. The TQM Journal (2008). doi:10.1108/17542730810881311.

[2] Walden, D. et al.: A special Issue on Kano's Methods for Understanding Customer-defined Quality. The Center for Quality Management Journal 2(4) (1993).

[3] Sanseverino, G., Schwanitz, S., Krumm, D., Odenwald, S., Lanzotti, A.: Understanding the effect of gloves on hand-arm vibrations in road cycling. Proceedings (2020). doi:10.3390/proceedings2020049070.



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