Optimum Design Project

Automobile Clutch Design

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Problem Formulation

1. Problem Statement

- Design a clutch which can endure the allowed stresses
- Minimize the material and production cost

Problem Formulation

2. Data and Information Collection

- Maximum Torque: 25.5kg ·m
- Maximum Velocity: 240km/h

3. Design Variables

- ro: outer radius
- ri: inner radius

Problem Formulation

4. Cost Function

$$f = \pi r_o^2$$

5. Constraints

$$-r_i(r_0^2 - r_i^2) + 2.1645 \times 10^{-3} \leq 0$$

$$r_0 > r_i > 0$$

Finding the optimality Solution

1. Analytically

A. Necessary condition

$$L = f + u(g + s^2)$$

$$\nabla L = 0$$

No.	ri	ro	u	Validity	f
1.	-0.1378	0	0	Not feasible	-
2.	0.1093	-0.1894	28.7319	Not feasible	-

Finding the optimality Solution

B. Sufficient condition

$$\nabla^2 g = \begin{bmatrix} 6r_i & -2r_o \\ -2r_o & -2r_i \end{bmatrix} \Rightarrow non\ \ positive\ \ definite$$

→ **Non convex**

$$\nabla^2 L = \begin{bmatrix} 6ur_i & -2ur_o \\ -2ur_o & 2\pi - 2ur_i \end{bmatrix} \Rightarrow positive\ \ definite$$

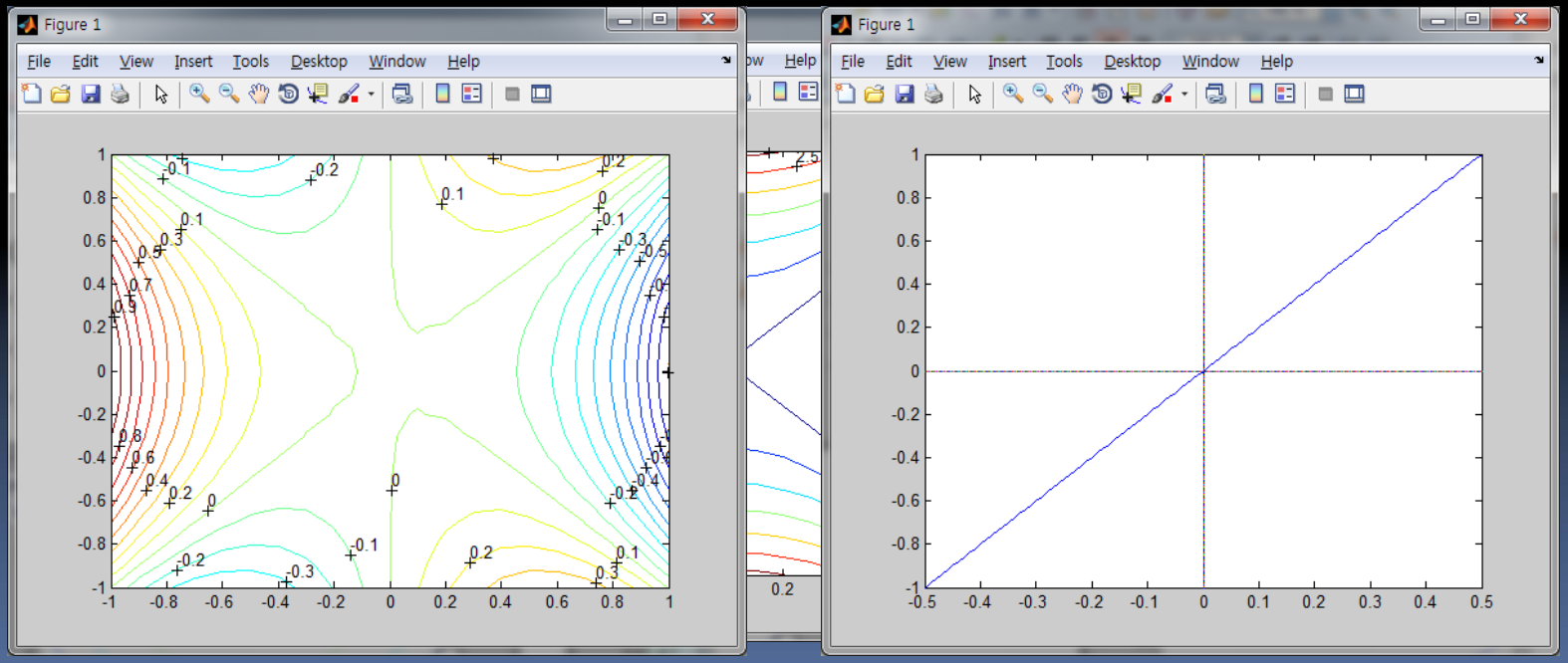
$$r_i = 0.1093 \quad r_o = 0.1894 \quad f = 0.1127$$

→ **Isolated local minimum**
Actually global minimum

Finding the optimality Solution

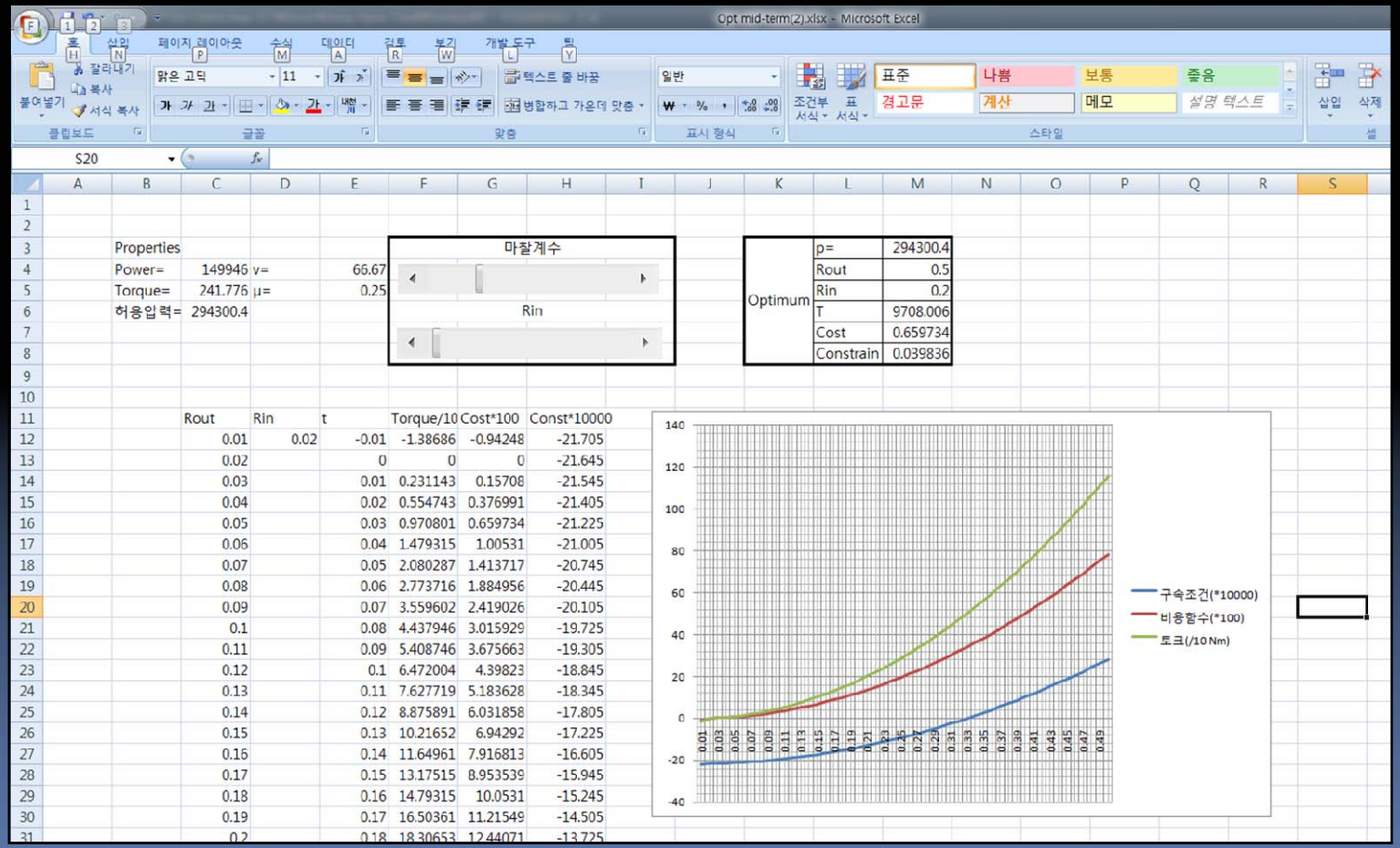
2. Graphically

A. Cost Function



Finding the optimality Solution

3. Considering other variables



Thank you all very much