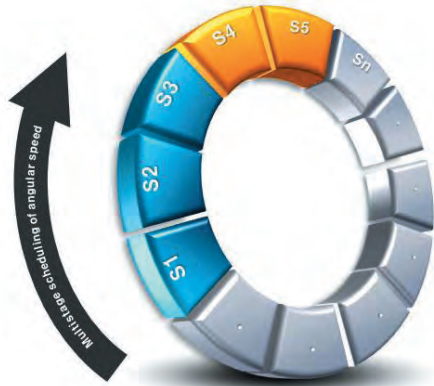


04

Multistage control method of flow control valve using DC motor



Division of individual angular speed limit areas depending on stages of DC motor

Precise flow rate control

Inventor

Senior Researcher Jung-yeop Lee

Team

Department of launch vehicle propulsion control

Status of right

- US : 9395703

Title

- MULTISTAGE CONTROL METHOD OF FLOW CONTROL VALVE USING DC MOTOR

TLO of the KARI

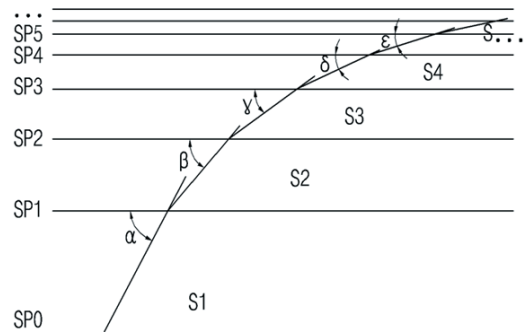
Person-in-charge
 Senior Administrator Moon-Hee, Cho
 E-mail : moonyp@kari.re.kr
 R&D Performance Diffusion Division

Outline of Technology

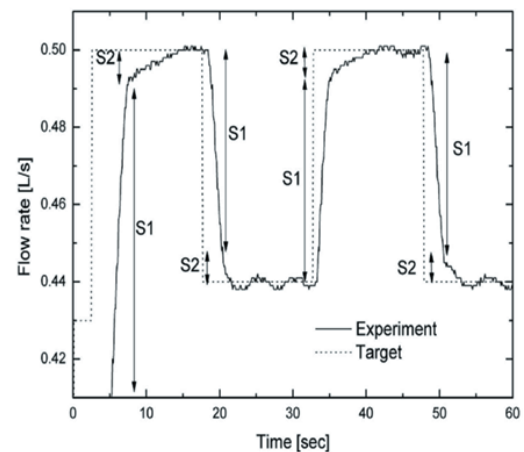
A technique for controlling a flow rate control valve by setting each limit value depending on stages according to angular speed components of a drive voltage that is applied during angular speed control over the DC motor and using a reference value of controlling target

The DC motor is rotated at an intended angular speed so that a control valve to which the DC motor is mounted is controlled, thereby enabling precise control of a flow rate.

Conceptual view of operation principle



Graph of flow rate control performance

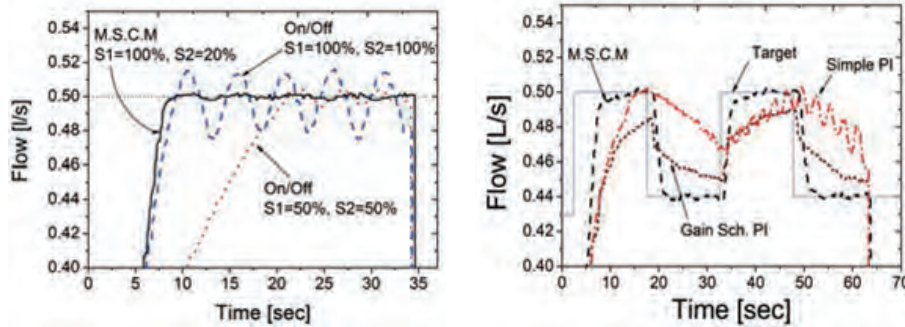


Technical features and advantages

Distinctiveness

- The DC motor can be rotated at a desired angular speed, and therefore precise control of a flow rate is possible.

Comparison of results of flow rate control by multistage control technique



Rapidly reaching a target value without overshoot or undershoot



Properly controlling a flow rate of a device whose thrust must be changed to a low thrust level



Additional tuning for controlling speed not necessary



Setting an appropriate target value based on information about the angular speed of the DC motor and by calculating the reduction ratio of gears



Simple driving mechanism and freely changeable design using electrical adjustment such as adjustment of a voltage



Technical effects

Speed control of DC motor

- Setting suitable limit values depending on stages according to angular speed components of a DC motor depending on a drive voltage that is applied during angular speed control over the DC motor, and executing speed control over the DC motor within a corresponding limit range -> A target value can be rapidly reached without overshoot or undershoot

DC motor rotatable at a desired angular speed

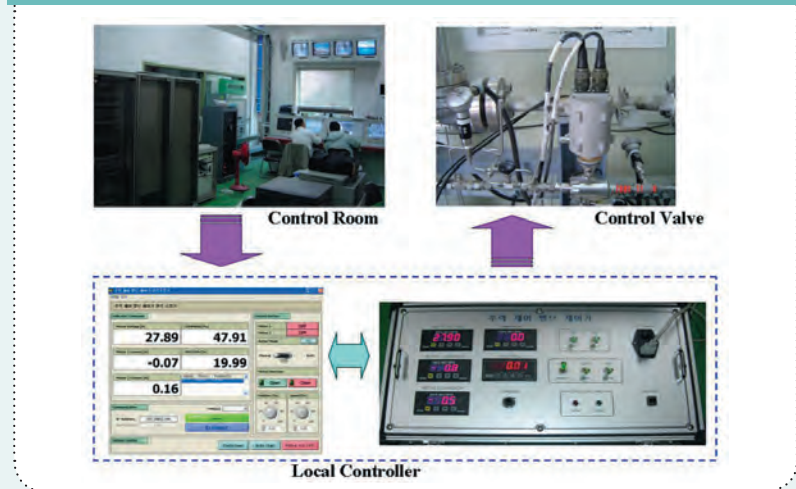
- DC motor rotatable at an intended angular speed, leading to precise flow rate control

Multistage control method of flow control valve using DC motor

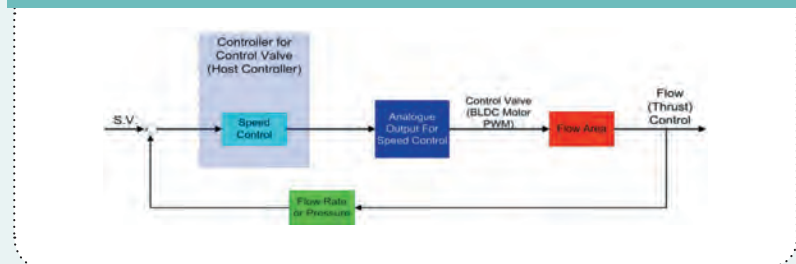
Technical detail

- For a proportional integral derivative (PID) controller which is widely used in the industry, while the result of dynamic characteristic is nonlinear during control, the result of the multistage control method is linear.
- In the multistage control method, there is no tuning procedure of trial and error which is a disadvantage of a PID controller.
- When controlling feedback, precise control is possible without overshoot or undershoot.

Controller for controlling a flow rate control valve



Flow rate control using multistage control method



Dividing angular speed limit areas of a DC motor depending on stages based on a plurality of limit values (SP1, SP2, SP3, SP4, ...) according to a driving voltage that is applied to the DC motor

Controlling the DC motor to rotate at a determined angular speed value depending on a corresponding angular speed instruction (S_n) to the DC motor within one angular speed limit area

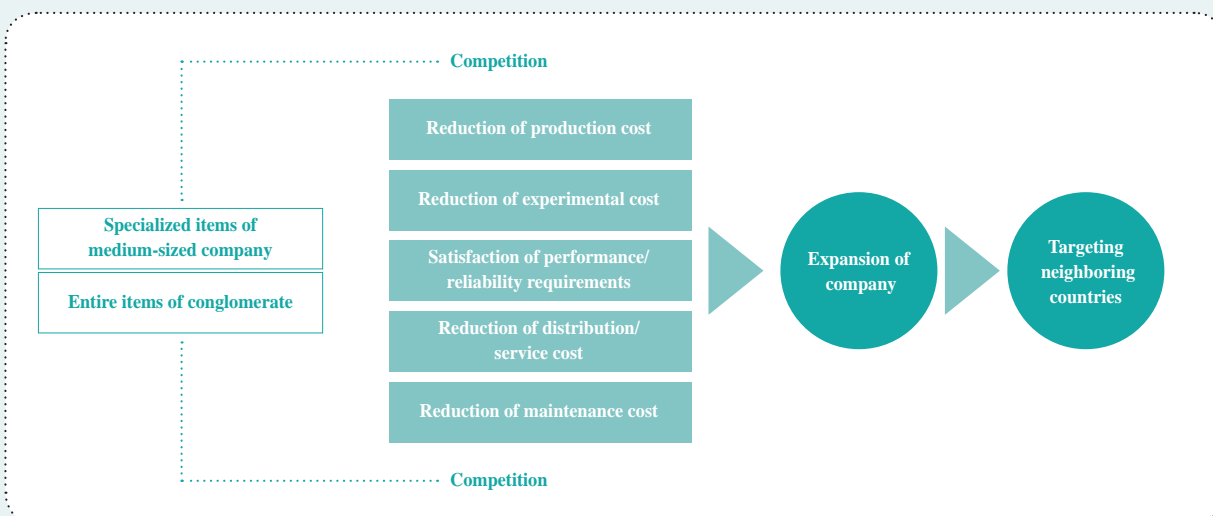
When the angular speed value of the DC motor is outside the range of a limit value (SP_n) of the angular speed limit area, the DC motor is controlled to rotate at a determined angular speed value within an angular speed limit area of a next stage.

Market and future prospect

- The global control valve market will likely rise at a CAGR of 6.4% during the period between 2017 and 2025. At this rate, the market which was worth \$6.01 billion in 2016 will likely become worth \$10.46 billion by 2024. In terms of volume, the global control valves market is expected to reach 13,734.6 thousand units in 2025.



- Market characteristics of control valve technique



Applications

Fields of precise flow rate control

Diversely applicable to the fields of aerospace, automobiles, watercraft, petrochemistry, development, construction, plant industry, etc. as an essential and core component

Fields of motor control

Robot, electric vehicle, etc.

