Optimizing Temperature Distribution of Electrodialysis Stacks for Hydrogen Production

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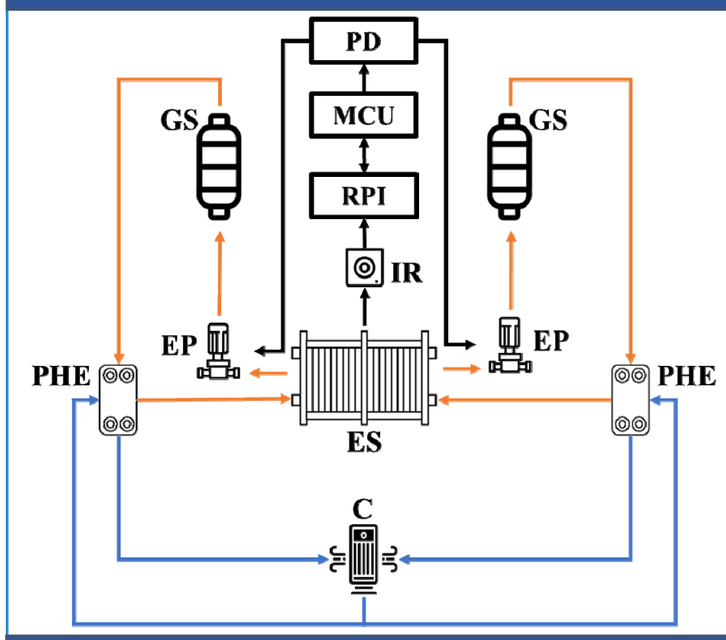
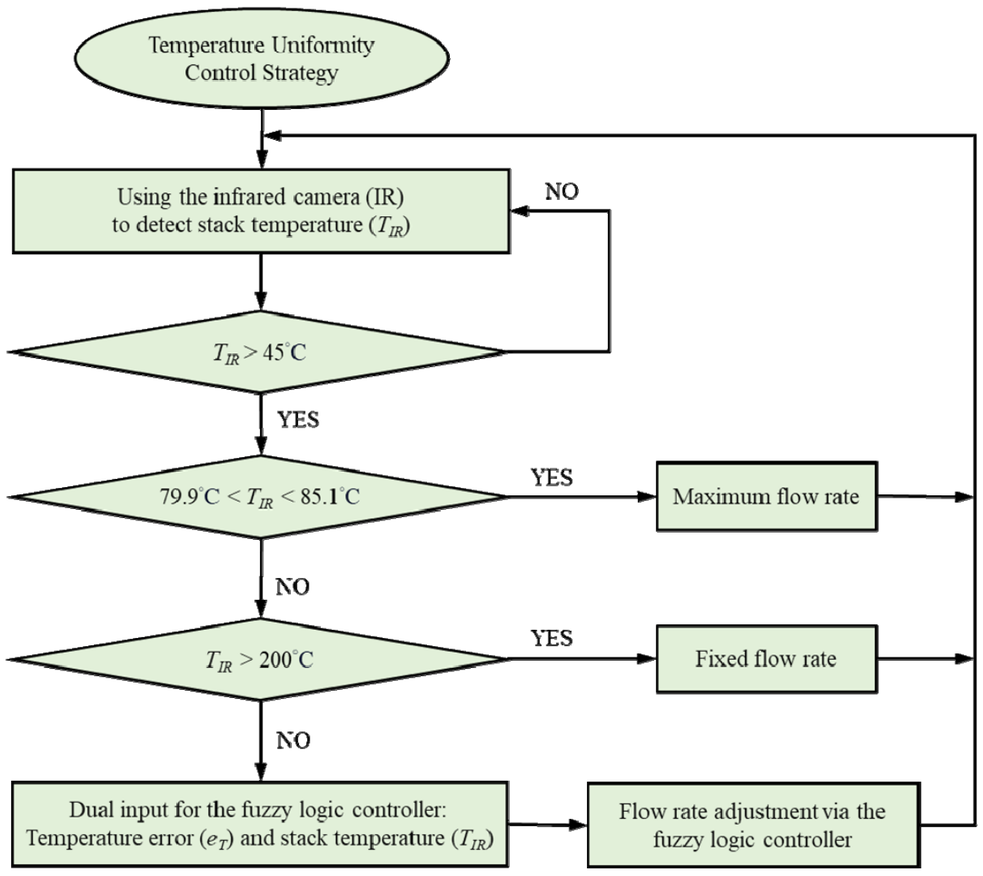
Introduction

- Hydrogen is regarded as a clean and renewable energy source. Its production not only features cleanliness and efficiency but also serves as an energy storage medium, addressing the issue of intermittent supply in renewable energy.
- Anion exchange membrane (AEM) electrolysis is a relatively new water electrolysis technology that combines the advantages of traditional alkaline water electrolysis and proton exchange membrane electrolysis.
- Infrared cameras can flexibly adapt to various shapes and sizes of fuel cells, providing comprehensive temperature information to optimize system operation and control strategies.
- In this study, an infrared camera (FLIR Lepton 3.5) has been selected as the temperature sensor to monitor the temperature distribution on the surface of the electrodialysis stack, and a fuzzy logic controller has been designed to enhance the temperature uniformity of the electrodialysis stack for hydrogen production.

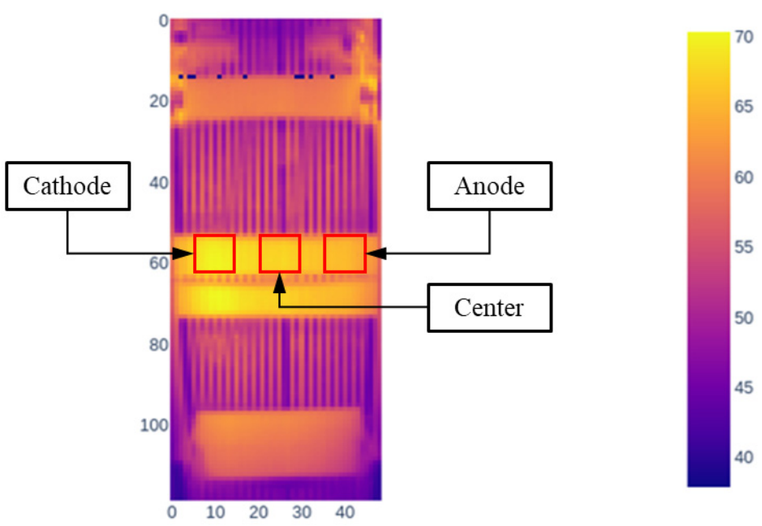
Hydrogen Production System with Stack Temperature Control



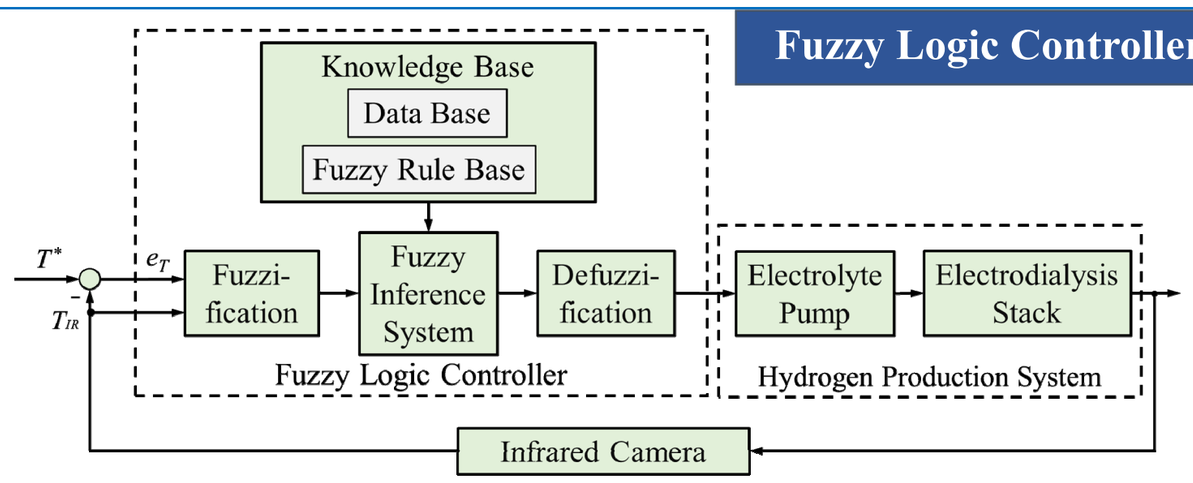
Temperature Uniformity Control Strategy



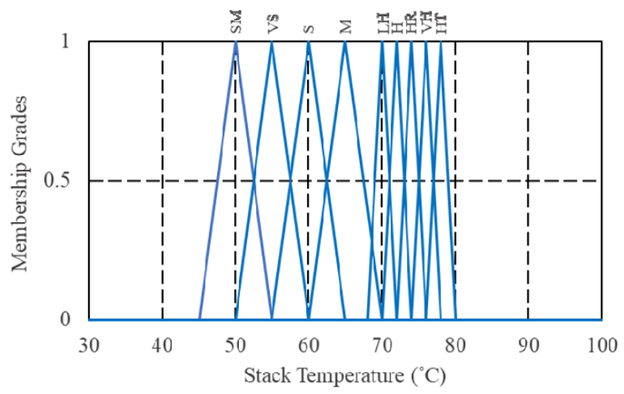
Infrared Image of Electrodialysis Stack for Hydrogen Production

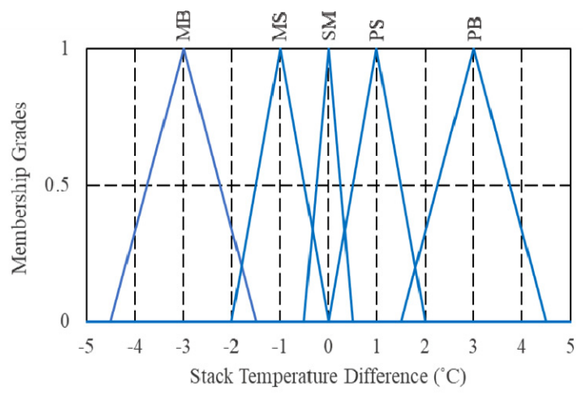


Fuzzy Logic Controller

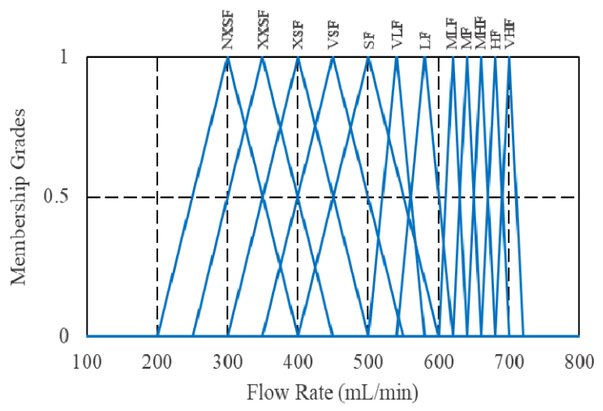


Membership Functions for Dual-input and Single-output



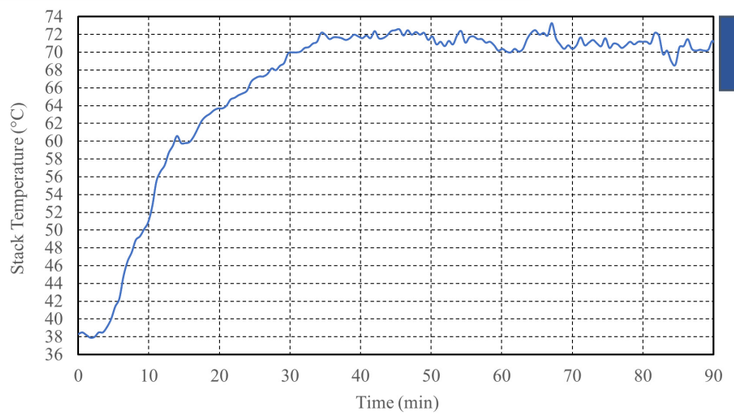


Stack Temperature	Stack Temperature Difference					
		MB	MS	SM	PS	PB
	SM	NXSF	NXSF	NXSF	NXSF	NXSF
	VS	XXSF	XXSF	XXSF	XXSF	XXSF
	S	XSF	XSF	XSF	XSF	XSF
	M	VLF	VLF	SF	VSF	VSF
	LH	MLF	MLF	LF	VLF	VLF
	H	MHF	MHF	MF	MLF	MLF
	HR	HF	HF	MHF	MHF	MHF
	VH	VHF	VHF	VHF	VHF	VHF
	HT	VHF	VHF	VHF	VHF	VHF

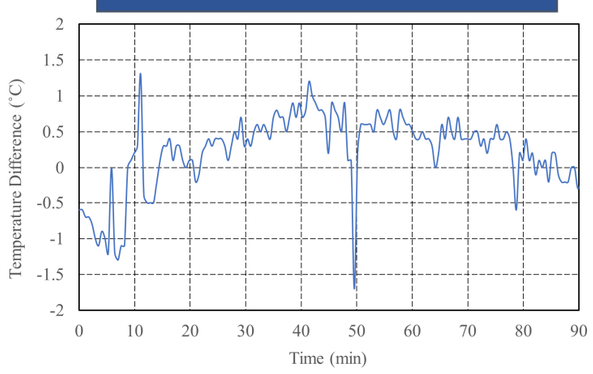


Experimental Results

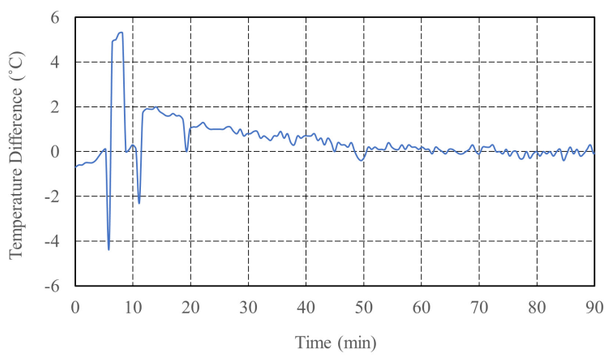
Stack Temperature



Temperature Difference between Anode and Stack Center Zones



Temperature Difference between Cathode and Stack Center Zones



Conclusions

- This study uses infrared thermal imaging technology to comprehensively monitor the overall temperature distribution of the electrodialysis stack, providing more comprehensive temperature information.
- The combination of infrared thermal imaging technology with fuzzy logic control has been achieved in this study to maintain the stack temperature within the optimal operating temperature range.
- The control strategy has improved the temperature uniformity of the electrodialysis stack and controlled the temperature difference within 3°C, thereby enhancing the reliability of the hydrogen production system.