Seminar class

Optimization Technique for Turbomachinery

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Campus: **Korea Institute of Industrial Technology (KITECH)**

Advisor: **Prof. Jin-Hyuk Kim**

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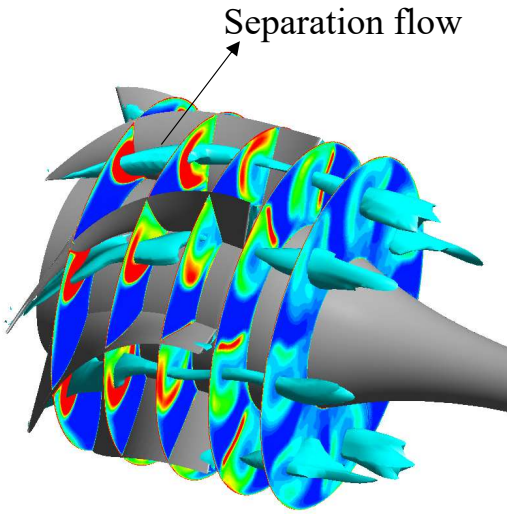
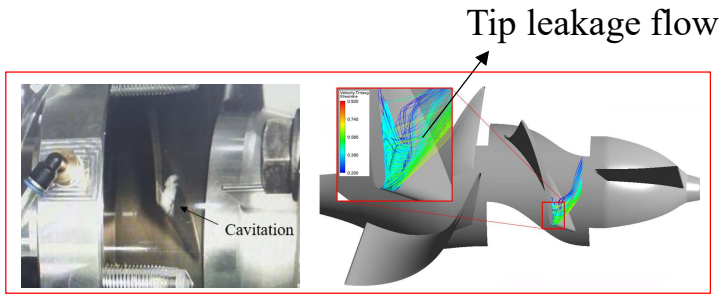
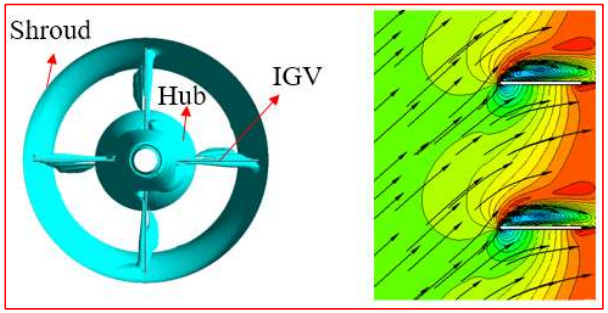
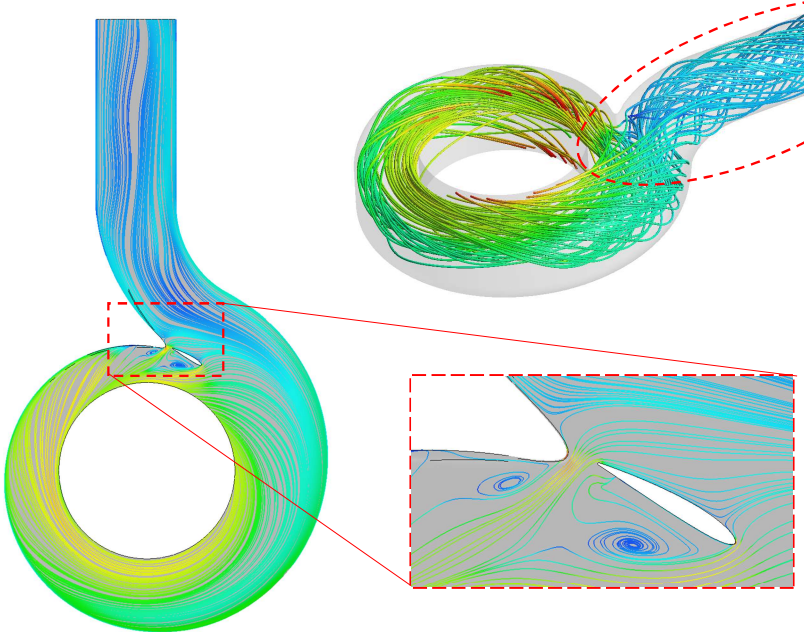
Why optimization? Motivation!

- Bad phenomena



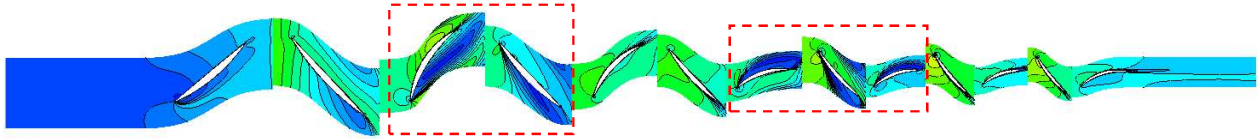






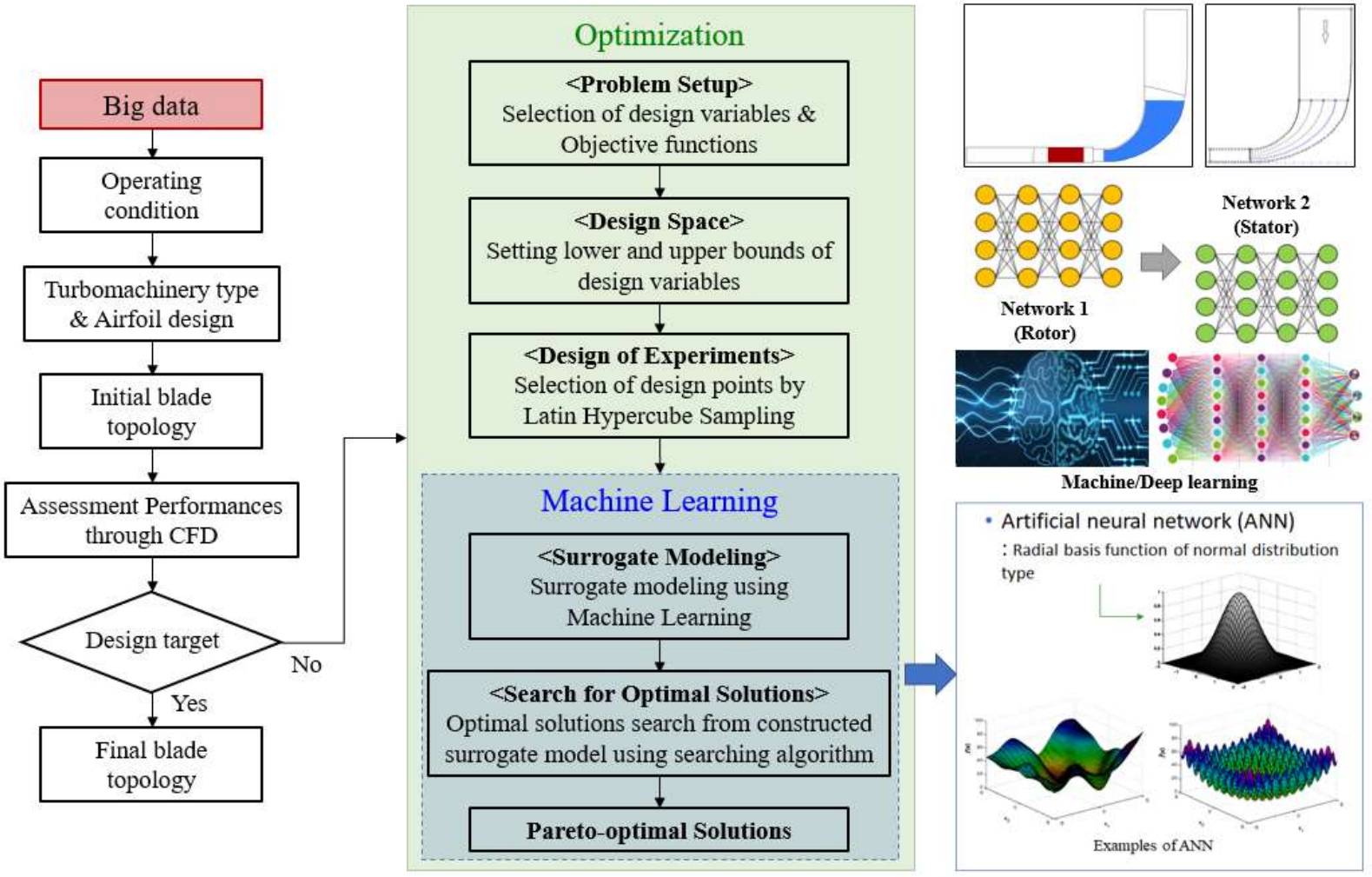
Improving Performance!

Flow Separation



Turbulence

Research Process



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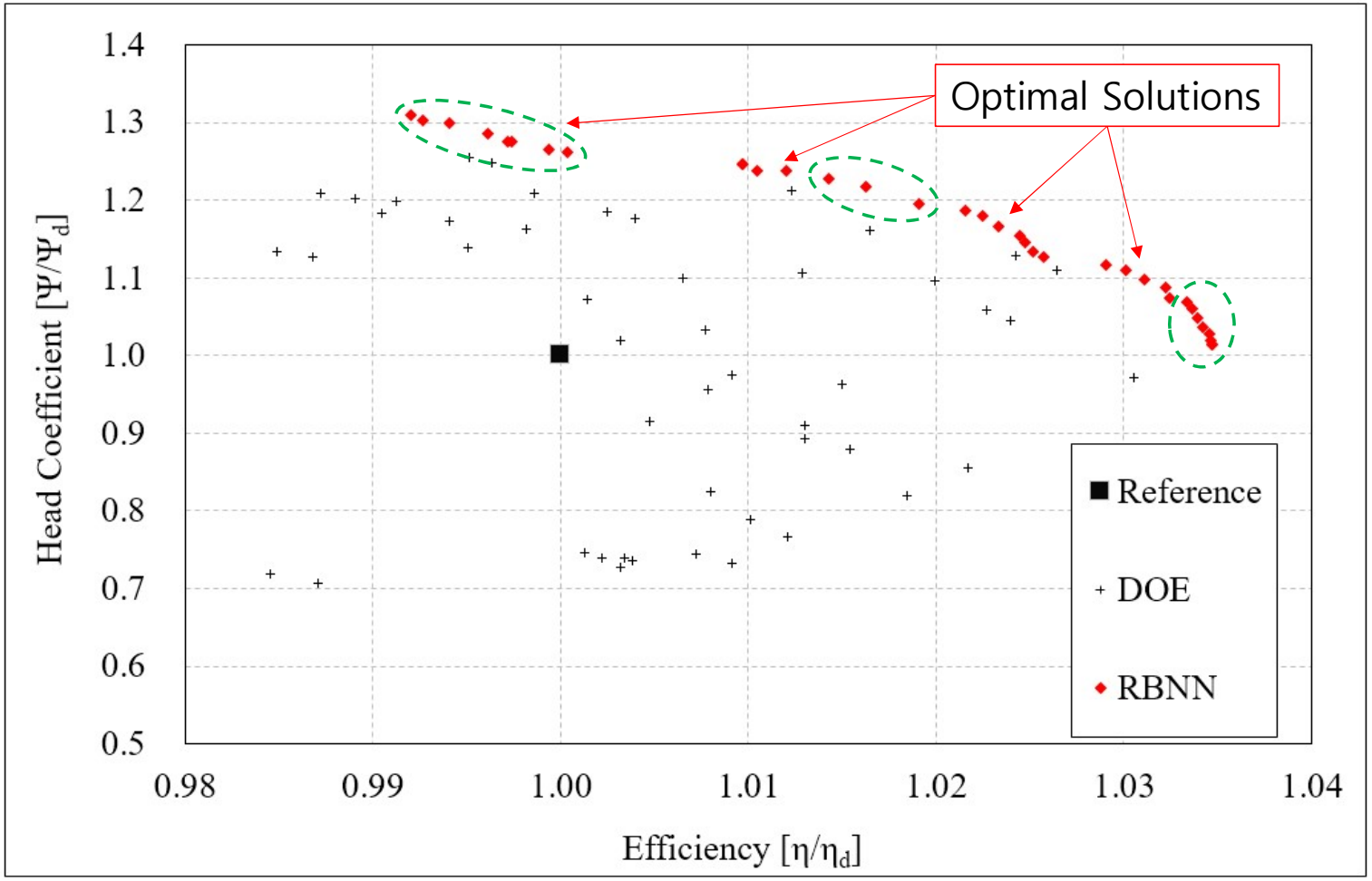
Prediction and Pareto Optimal Solution

- Multi-objective Function

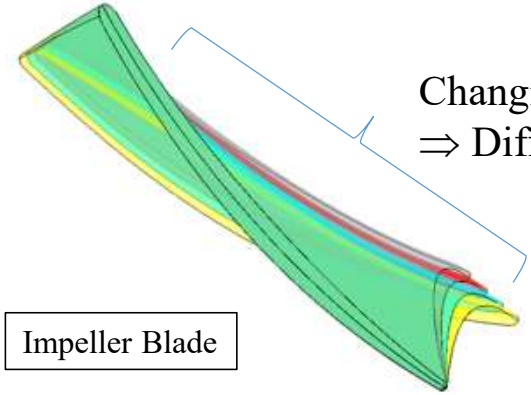
$\uparrow Efficiency \rightarrow \downarrow Head$

$\uparrow Head \rightarrow \downarrow Efficiency$



Prediction and Pareto Optimal Solution

	Design variables				*Predicted values*		*CFD Calculation*		*Predicted error (%)*		*Increment (%)*	
	L_s	L_h	ξ_m	$\beta_{1,m}$	η/η_d	H/H_d	η/η_d	H/H_d	η_t	H_t	η_t	H_t
Case 1	+5.447	-5.461	-0.217	+0.226	1.032	1.064	1.026	1.066	0.618	0.120	2.606	6.554
Case 2	+4.925	-1.289	-2.749	-1.616	1.018	1.198	1.013	1.196	0.514	0.155	1.270	19.627
Case 3	+5.831	-5.377	-3.665	+2.89	0.996	1.284	1.006	1.215	0.991	5.436	0.603	21.457

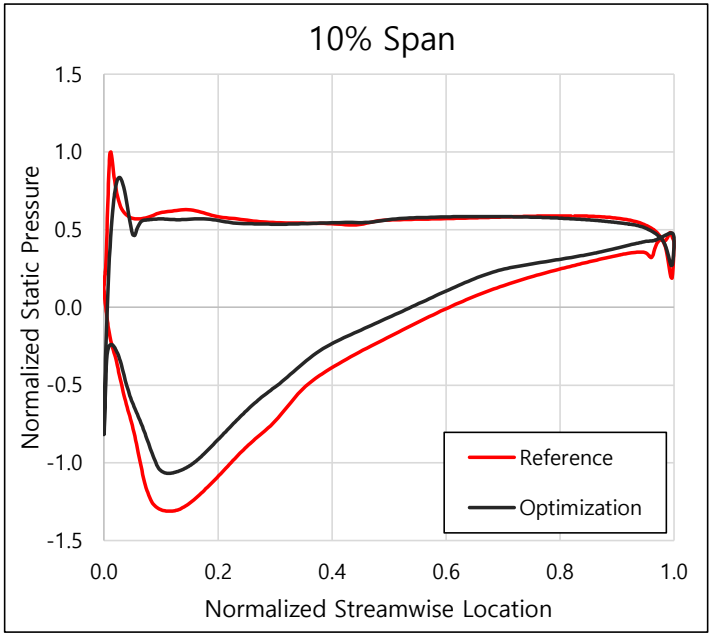


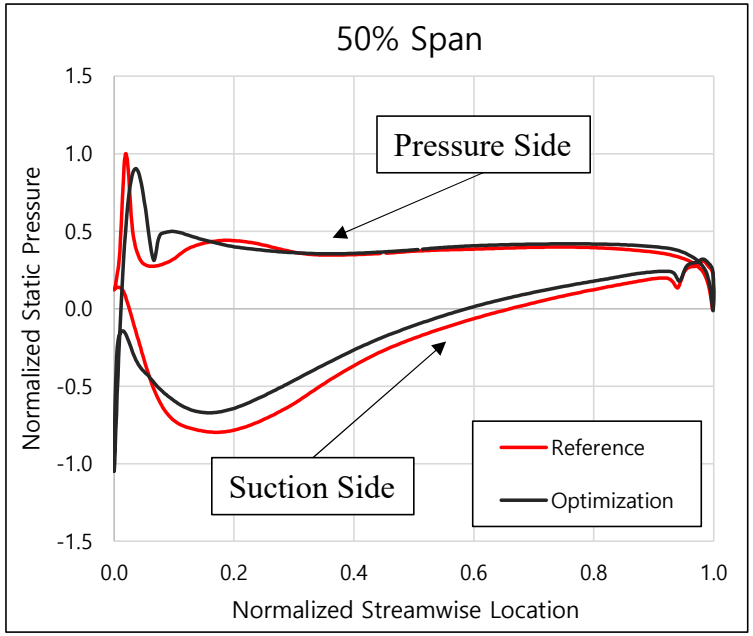
Impeller Blade

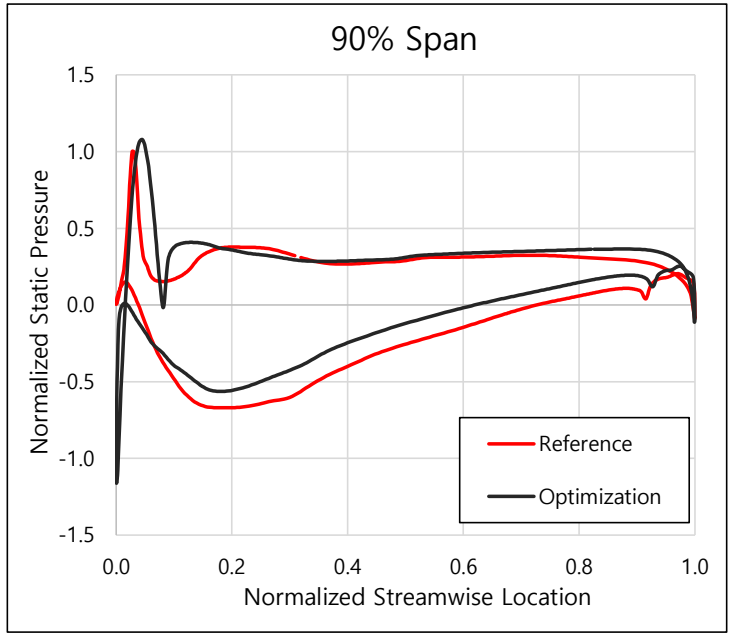
Changing values of design valuable
⇒ Different impeller geometry

Result Analysis

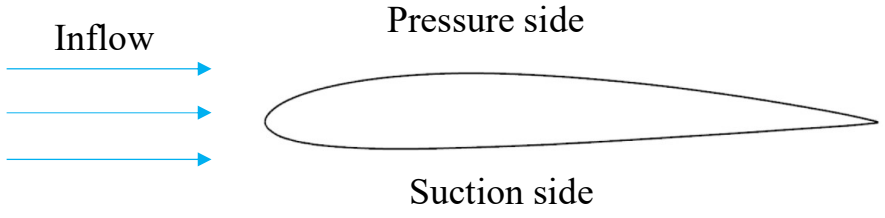
➢ Pressure distribution in impeller

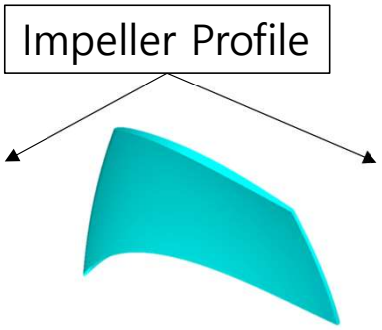


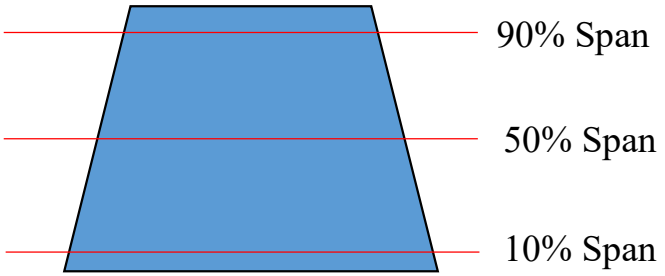




➢ Note

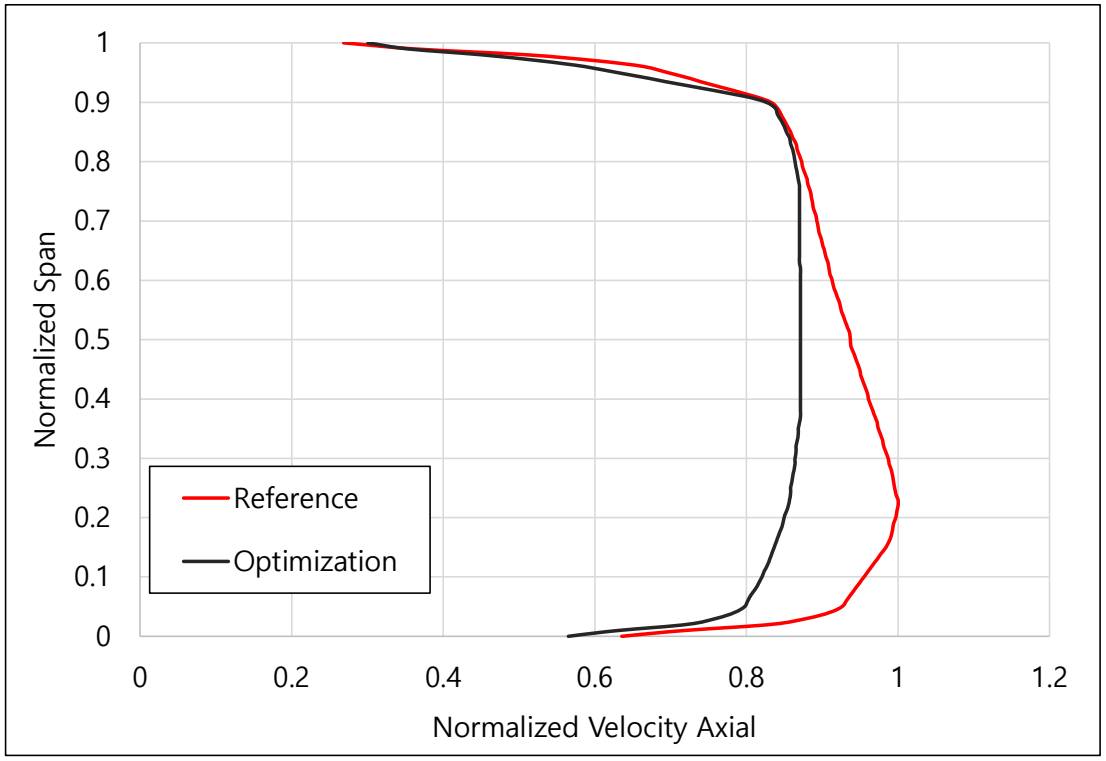


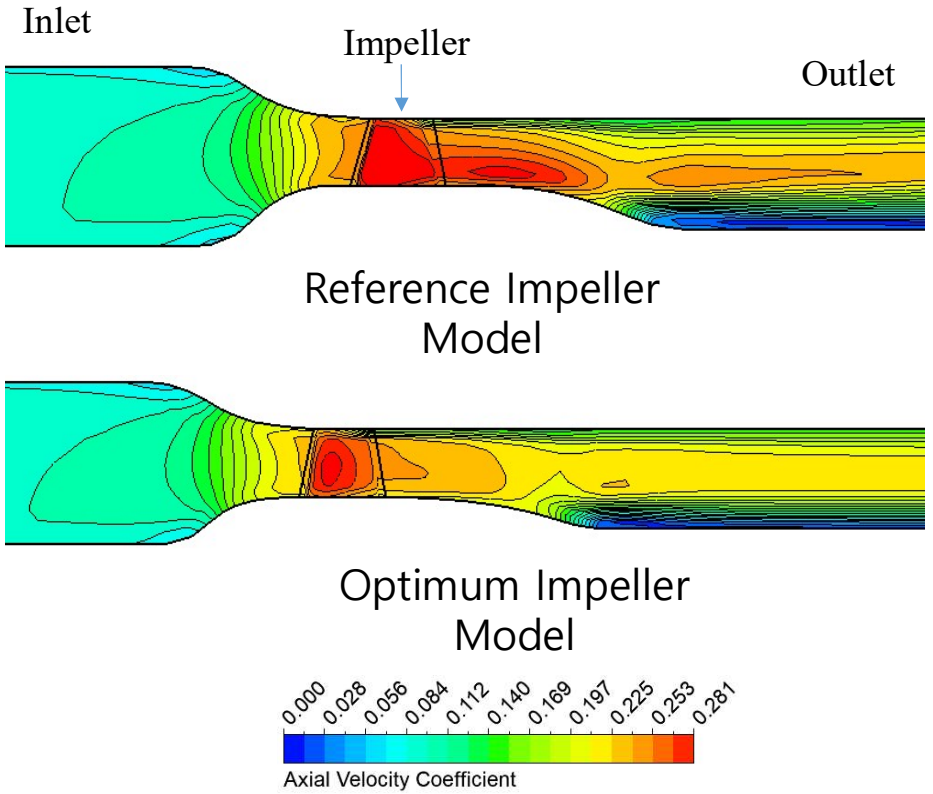




Result Analysis

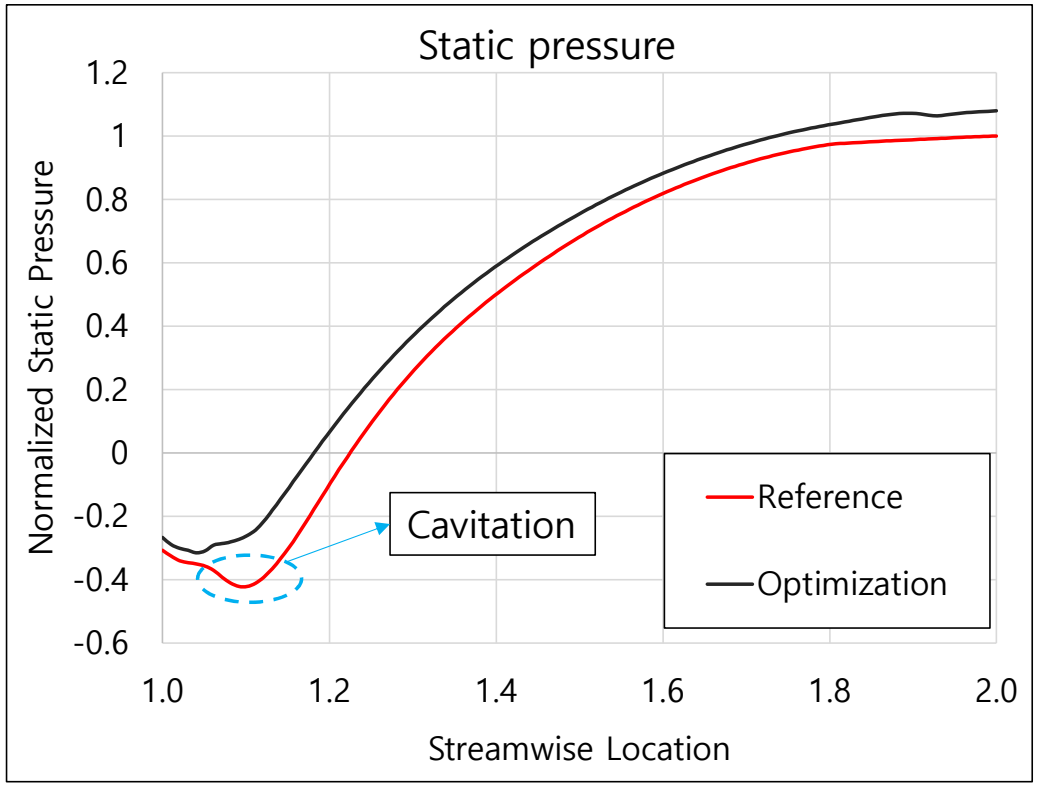
➢ Velocity axial distributions at impeller outlet

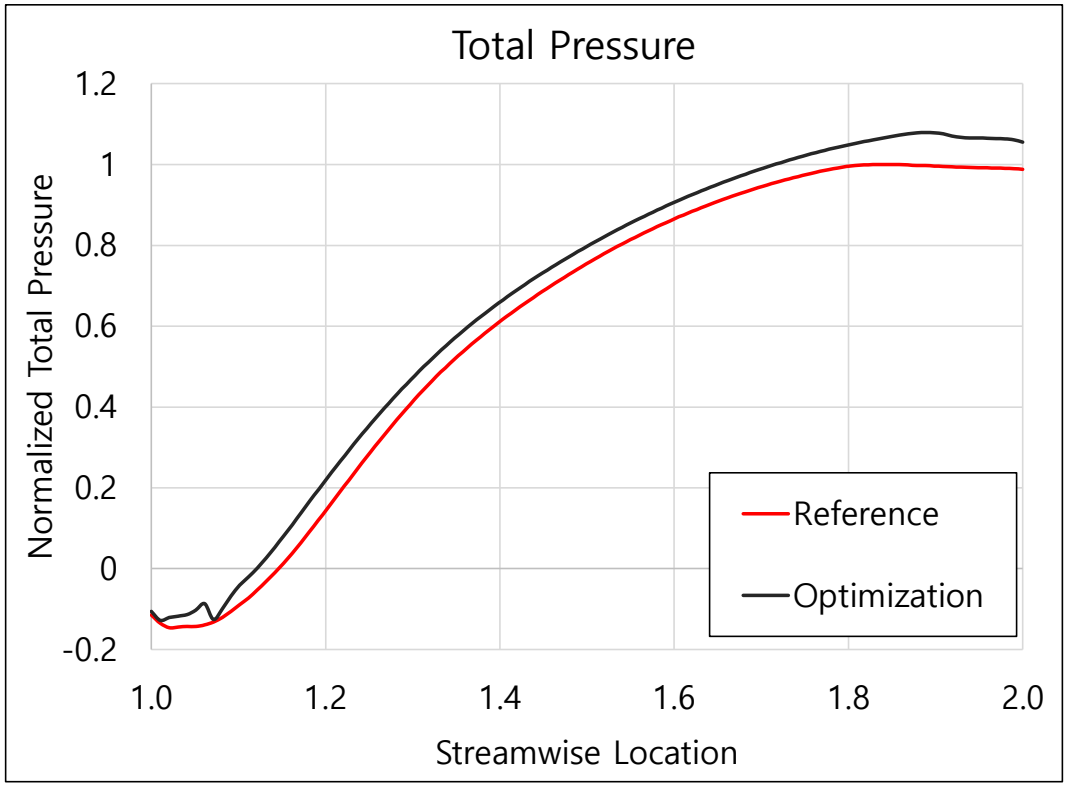




Result Analysis

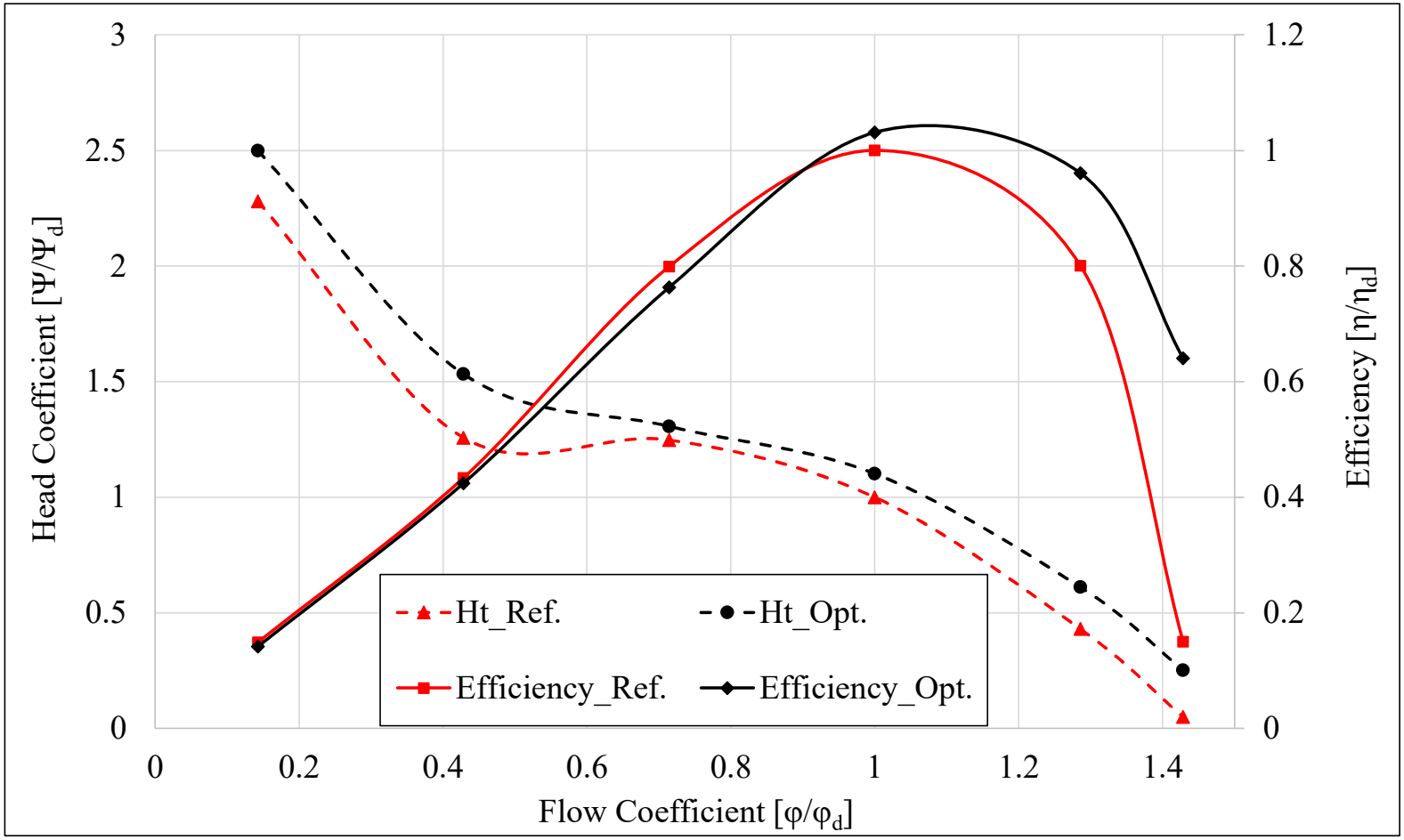
- Pressure distribution at 50% span





Result Analysis

- Comparison energy performance curves



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Conclusions

- The impeller geometry of an axial flow pump were optimized by multi-objective optimization.
- The objective functions were the total efficiency and total head.
- The main influencing factors were screened through a 2^k factorial design analysis (DOE).
- The design points were then created in the design space using Latin Hypercube Sampling (LHS).
- The approximation model uses a radial basis neural network (RBNN).
- The optimal design was found using Non-dominated Sorting Genetic Algorithm (NSGA-II).
- The optimum model is increased the total efficiency and total pressure head by 0.974% and 21.028%, respectively, from those of the original model.
- The hydraulic performance was significantly enhanced by redistribution of the velocity field at the outlet and low-pressure suppression in front of the impeller.

Achievement

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Keywords:
· Axial flow pump
· Diffuser vane
· Impeller
· Multi-objective optimization
· Optimization design

Hydrodynamic optimization of the impeller and diffuser vane of an axial-flow pump

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Thank You For Listening

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