

A Hydraulic Hybrid Architecture combining an Open Center with a Constant Pressure System for Excavators

Hijikata Seiji

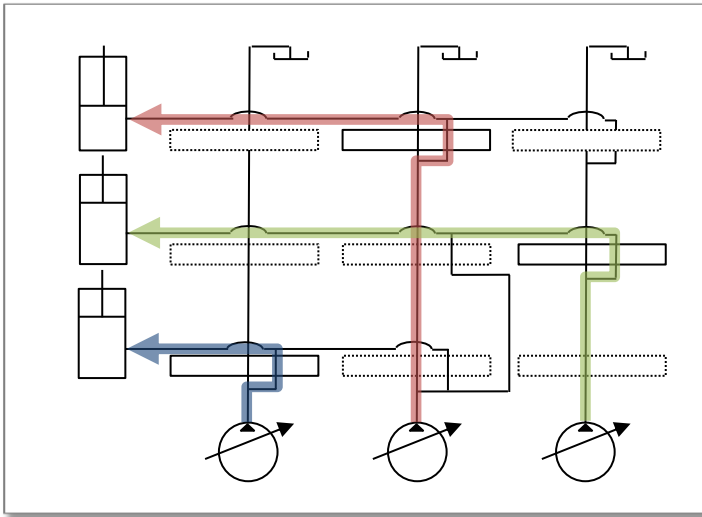


- 1 Introduction
- 2 Design of New System
- 3 Simulation
- 4 Conclusion and Outlook

Introduction of Hydraulic Systems

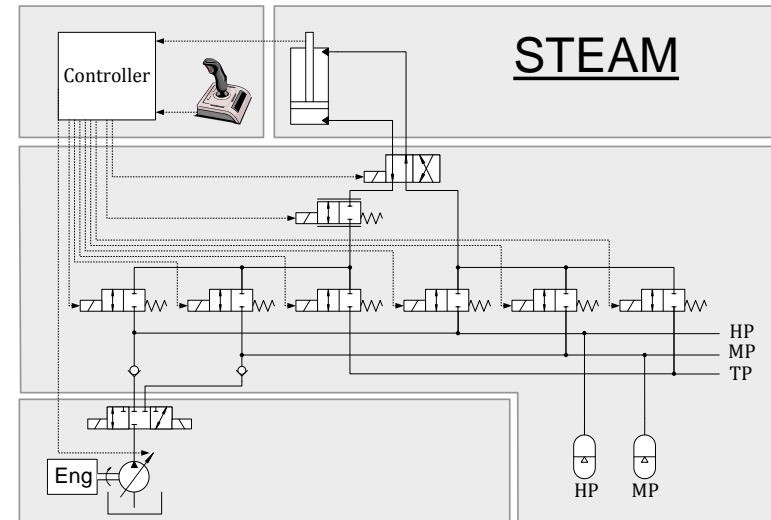
Reference

Three Pump Open Center System



- High efficiency of hydraulic system
- Energy can not be recuperated.
- Large idle losses

Constant Pressure System



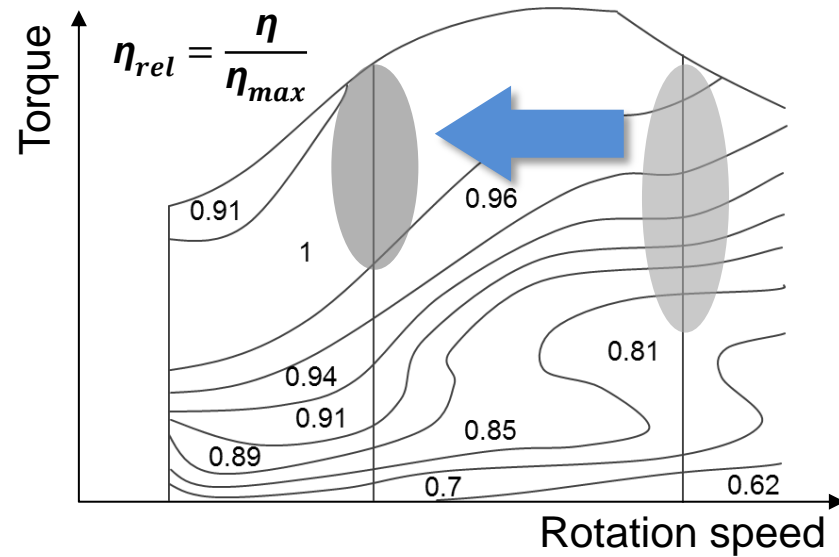
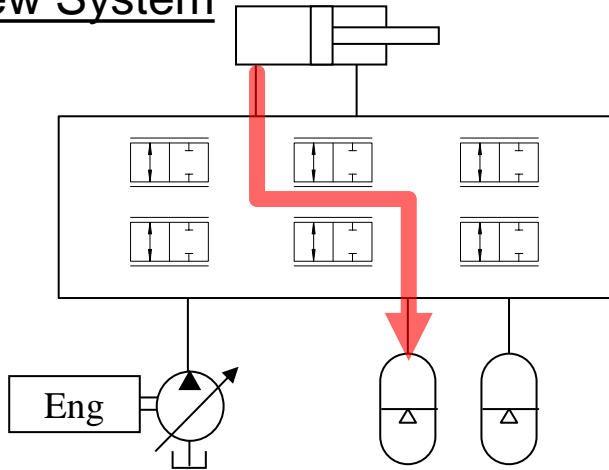
- High efficiency of engine operation
- Energy can be recuperated.
- Large number of the valves

To design a new hybrid sytem which combines open center with constant pressure system

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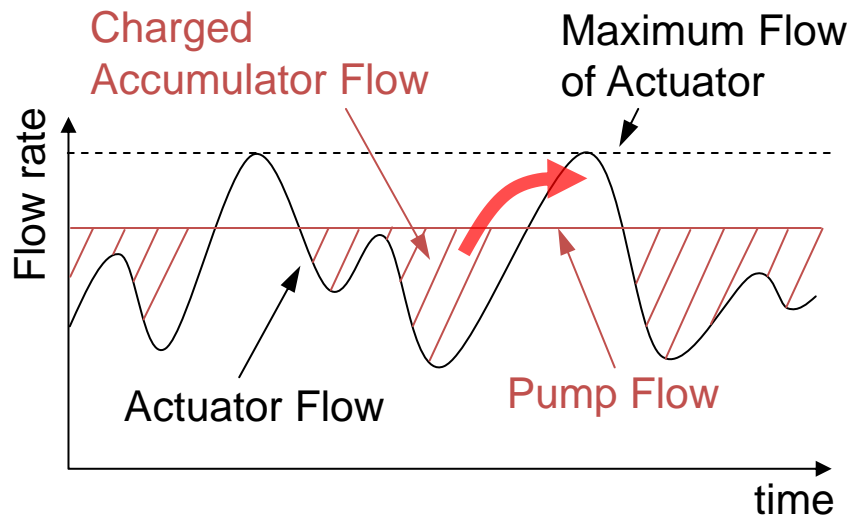
Basic Principles of New System

New System



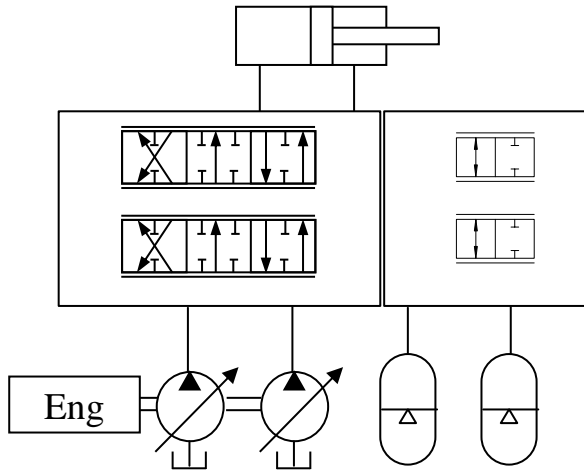
High efficiency engine operation

Recuperating energy



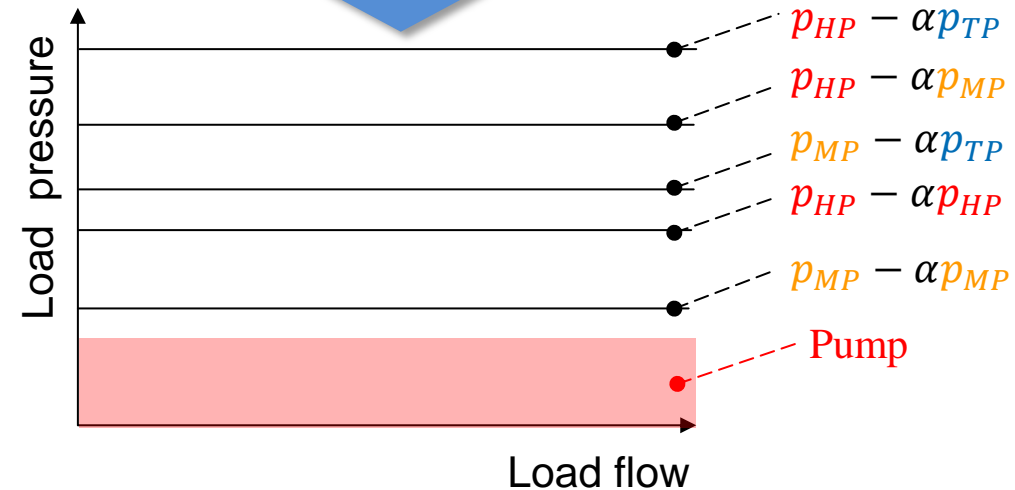
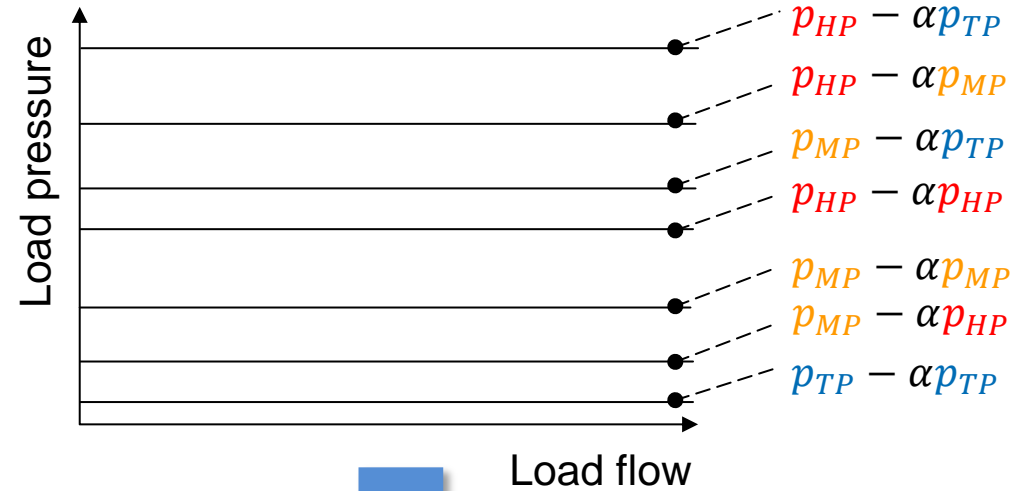
Basic Principles of New System

New System

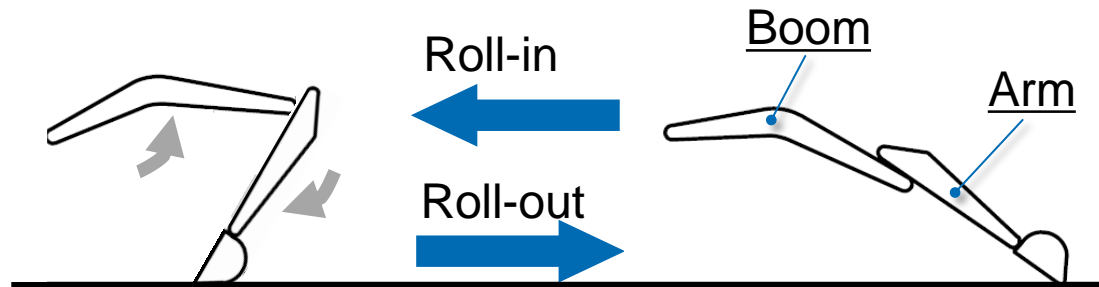


Flow rate is provided by pump directly.

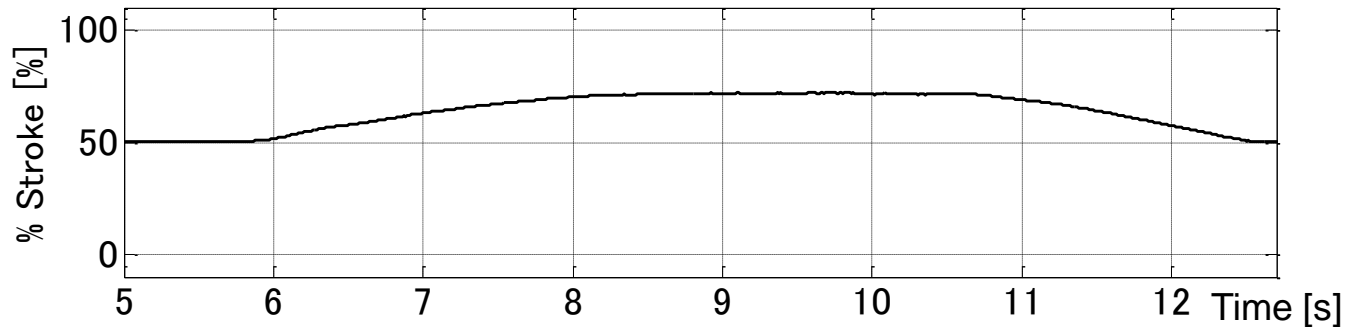
2 pump open center valves are used.



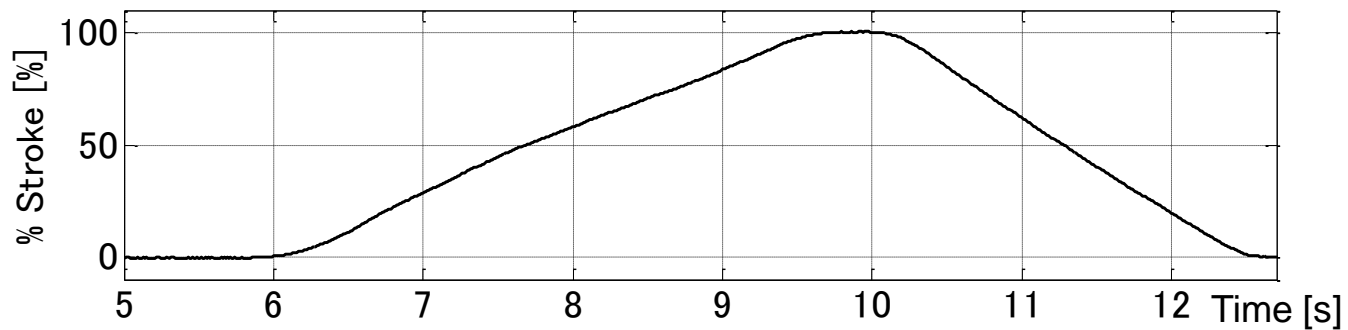
Levelling Cycle



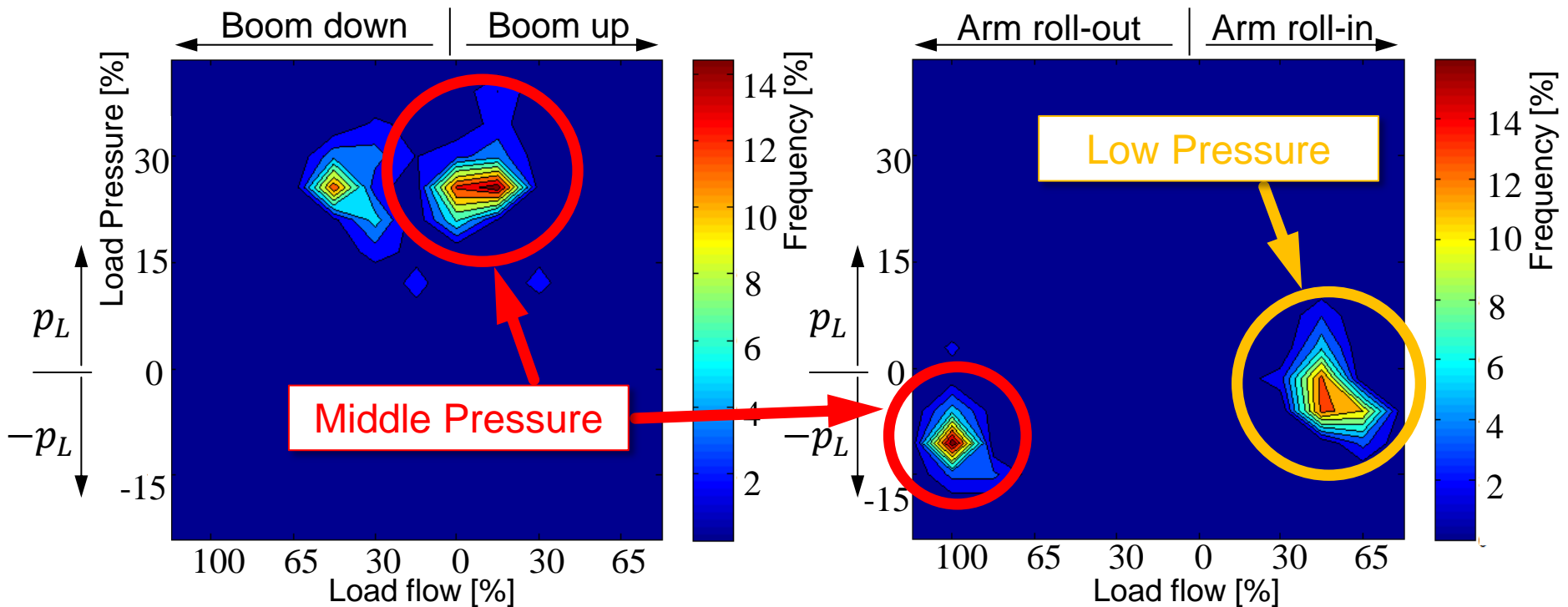
Boom



Arm

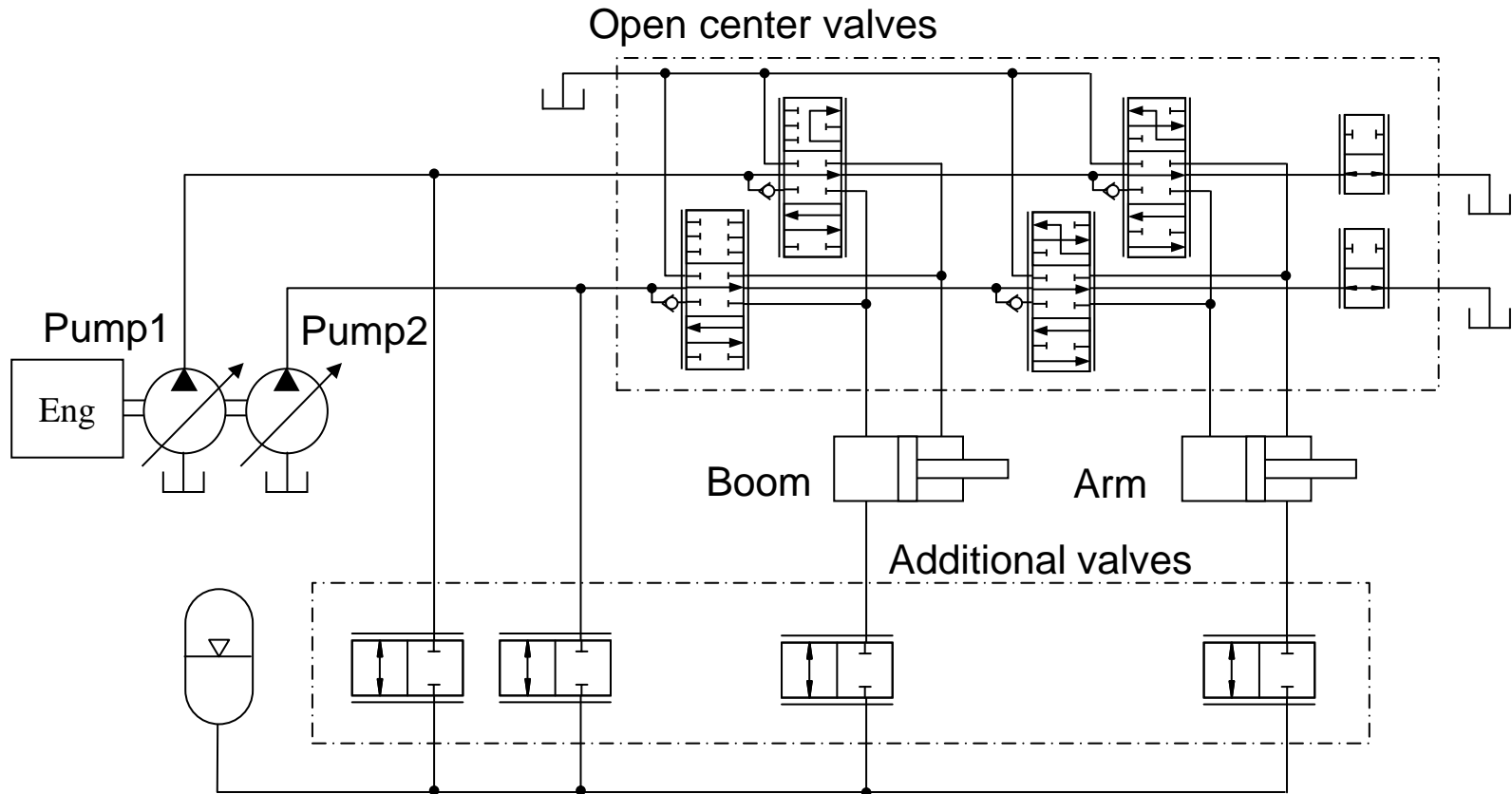


Data Analysis of Levelling Cycle



Motions	Pump1	Pump2	Accumulator
Levelling Roll-in	- Arm	- Arm	- Boom
Levelling Roll-out	- Accumulator charge	- Accumulator charge	- Arm - Boom recuperation

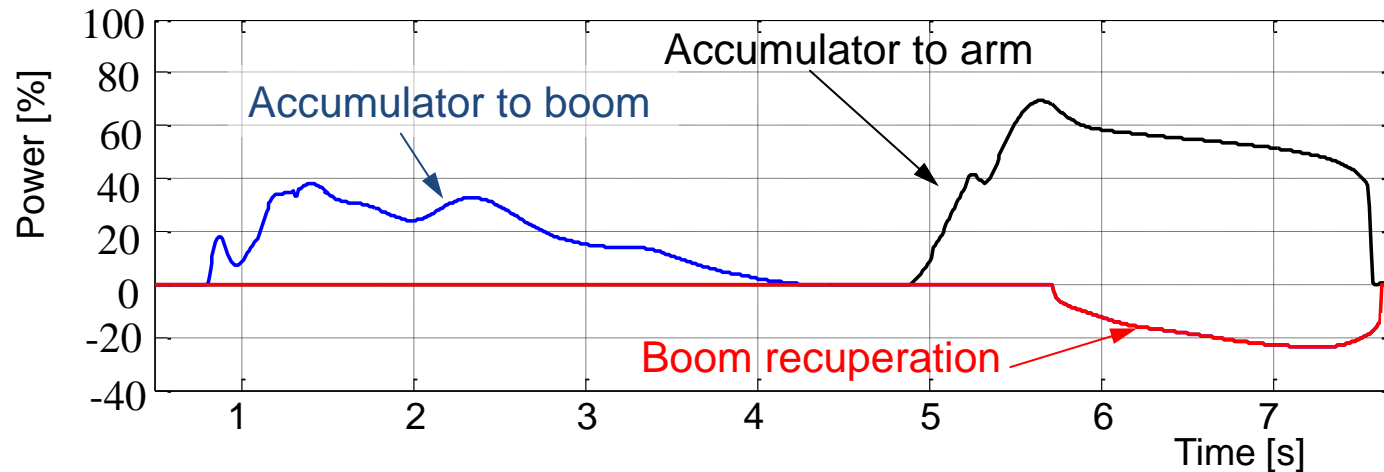
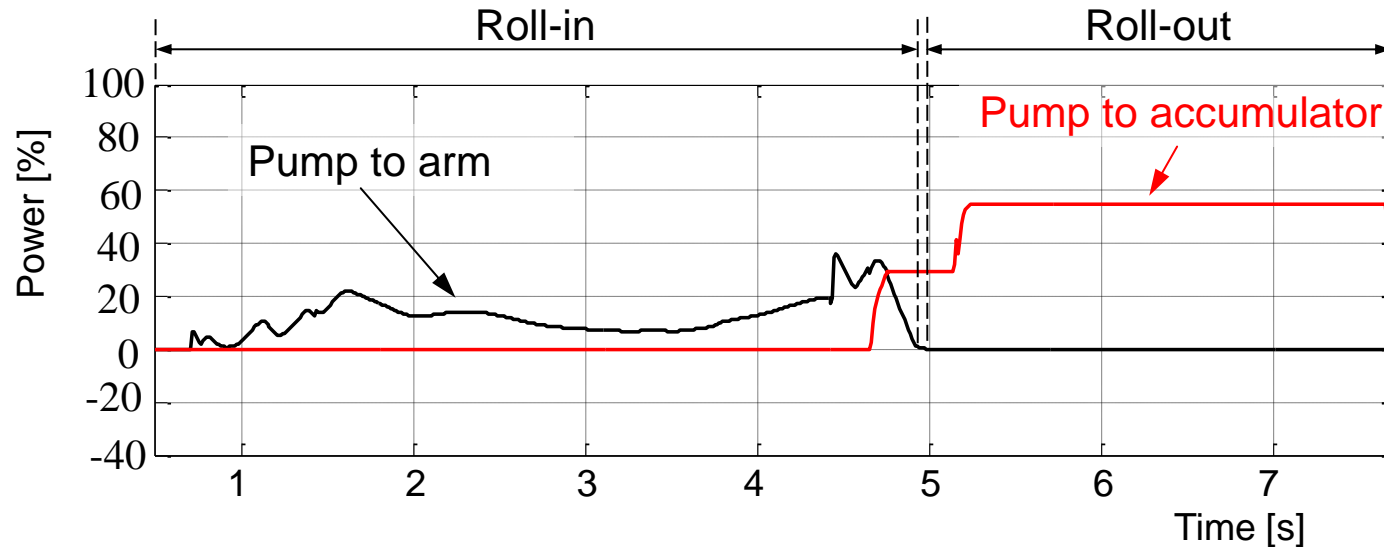
Hydraulic Circuit of New System



The number of valves can be reduced by using the open center valves.

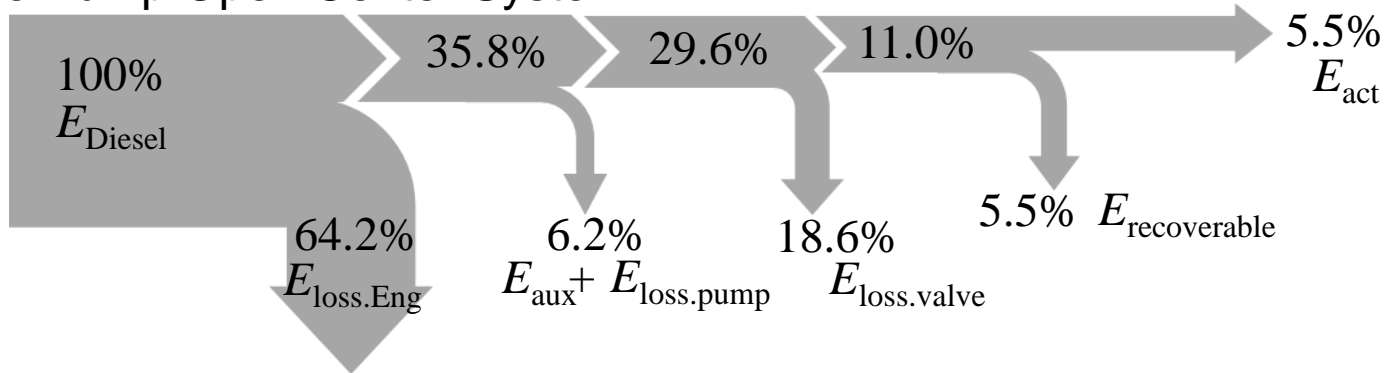
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Simulation – Cycle Power Analysis

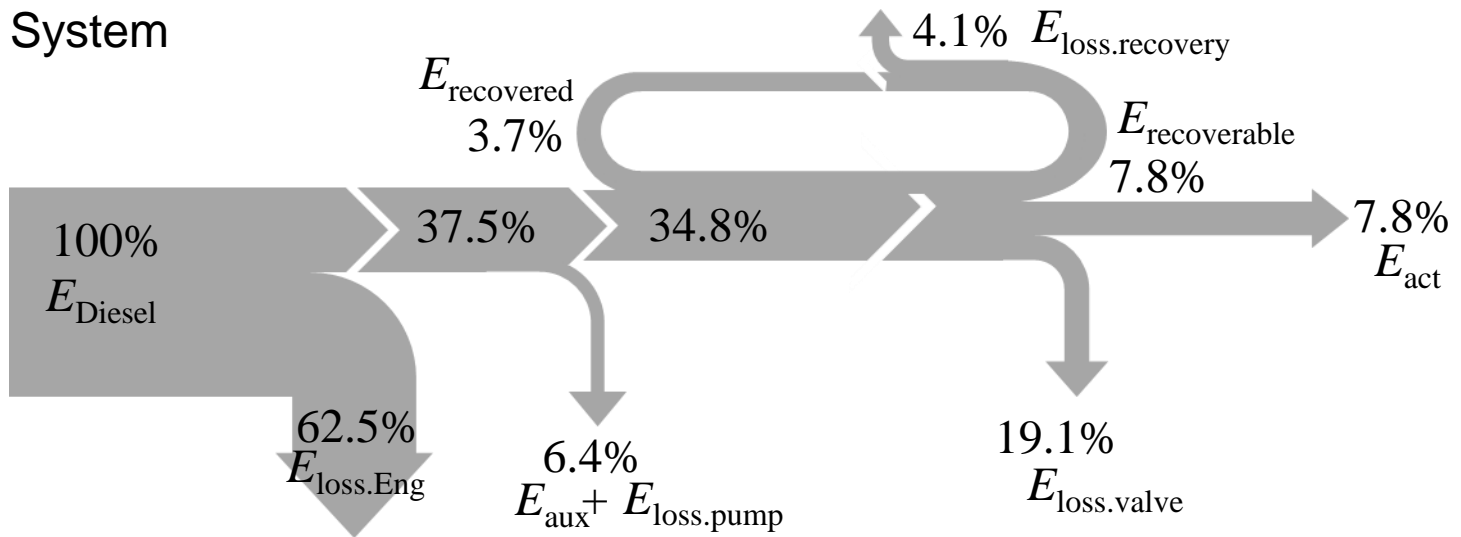


Sankey Diagram for System Efficiency

- Three Pump Open Center System

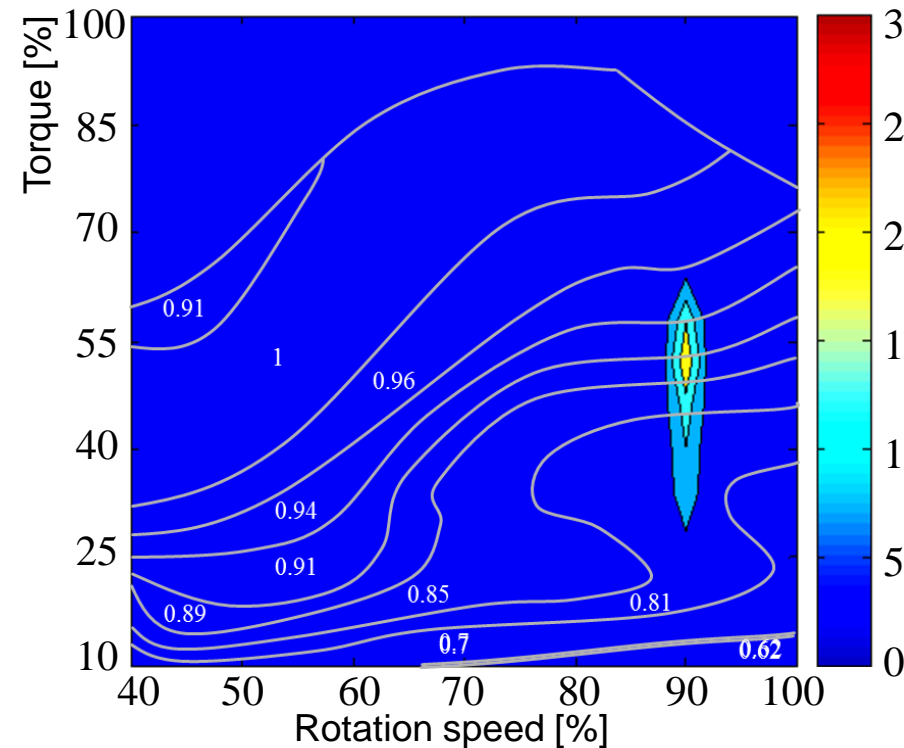


- New System

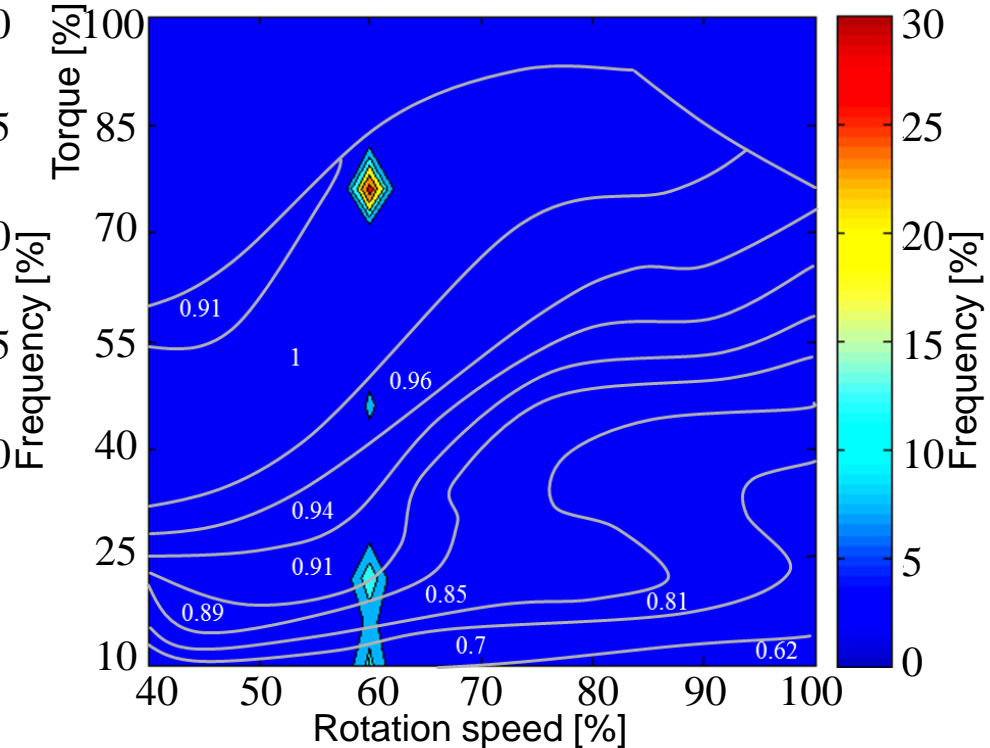


Engine Operation with Efficiency Map

Three Pump Open Center System



New System



The new system shows potential 30 % less fuel compared to three pump open center system.

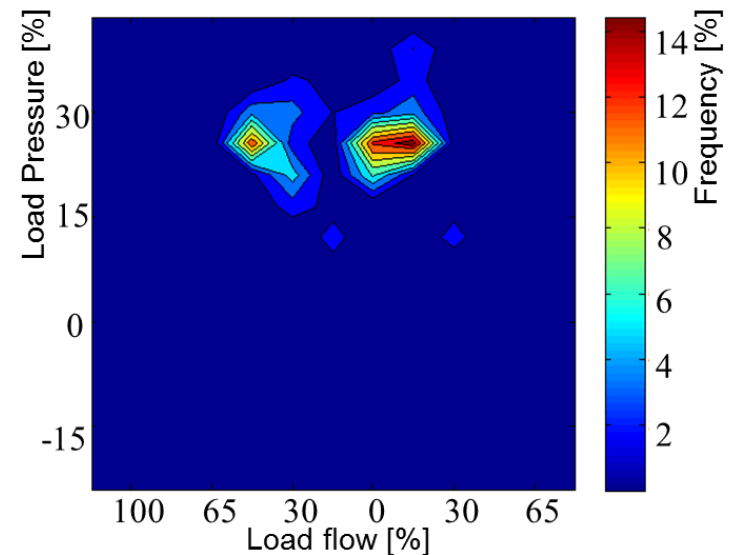
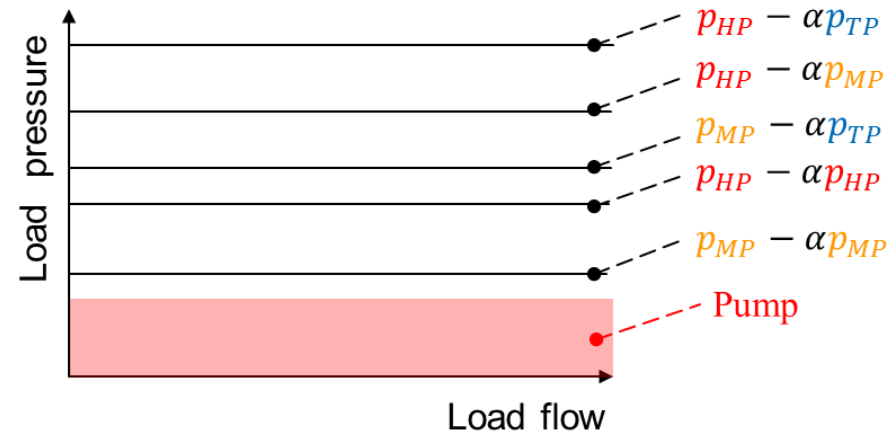
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Conclusion

- Basic principles for the new system was shown with analysis of measurement data.
- The hydraulic circuit for the new system was explained.
- The new system has consumed 30 % less fuel than three pump open center system.

Outlook

- Experiments will be conducted with a test rig.



Thank you for your attention!

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