



# A method of improving the efficiency of axial-piston hydraulic motors

**A method of improving the energy efficiency of a hydraulic motor by rotating a valve cam for variable piston stroke**

**IP Status: Provisional Patent Application Filed (app. no. 63/404,236)**

## Applications

- This technology may be applied to axial piston variable displacement pumps/motors in general if cam-based distributor valves are used instead of valve plates.
- In particular, the hydraulic motor in a line of inline hydromechanical transmissions (iHMT) - known as Hondamatic, is a viable application.
- The original Hondamatic was utilized in ATVs but similar designs are feasible in a wider range of applications, including on-road vehicles.
- The invention may also be applied to standalone variable-displacement hydraulic motors to improve power efficiency in any existing application.

## Key Benefits & Differentiators

- **Simpler**
- **More precise**
- **More compact**
- **Significantly less expensive to implement**

## Technology Overview

A typical axial-piston hydraulic motor with an adjustable swashplate and fixed valve timing cannot achieve ideal precompression and decompression across a range of operating conditions. This results in a loss in energy leading to a loss in efficiency for hydraulic motors used in All Terrain Vehicles and on-road vehicles.

Researchers at the University of Minnesota have developed a method of improving the motor's energy efficiency by rotating a valve cam for variable piston stroke. This allows, for each desired effective displacement of the hydraulic motor, a set of ideal valve timing to achieve perfect precompression and decompression so as to eliminate associated throttling losses. Efficiency improvements of as much as 10% can be achieved. This technology may be applied to axial piston variable displacement pumps/motors in general if cam-based distributor valves are used instead of valve plates. In particular, the hydraulic motor in a line of inline hydromechanical transmissions (iHMT) - known as Hondamatic, is a viable application. The Hondamatic already uses cam-based distributor valves for valve timing, The proposed method significantly improves the motor's efficiency in the iHMT. The design has been simulated, demonstrating efficiency improvements of up to 14.4% when applied to a motor in an inline hydromechanical transmission.

## Phase of Development

**TRL: 3-4 Simulations of design have been completed**

**Technology ID**

2023-001

## Category

Engineering & Physical Sciences/Design Specifications  
Engineering & Physical Sciences/Energy  
Engineering & Physical Sciences/Transportation

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## Researchers

- [Perry Y. Li](#) Professor, Department of Mechanical Engineering

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## References

1. Evan D. Sand, Perry Y. Li , Incorporating A Rotatable Valve Cam To Improve The Efficiency Of A Hydraulic Motor In An Inline Hydro-Mechanical Transmission (I-Hmt), Proceedings of 2022 Bath/ASME Symposium on Fluid Power and Motion Control