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Modelling and validation of a roller-cam rail mechanism used in a 2D piston pump

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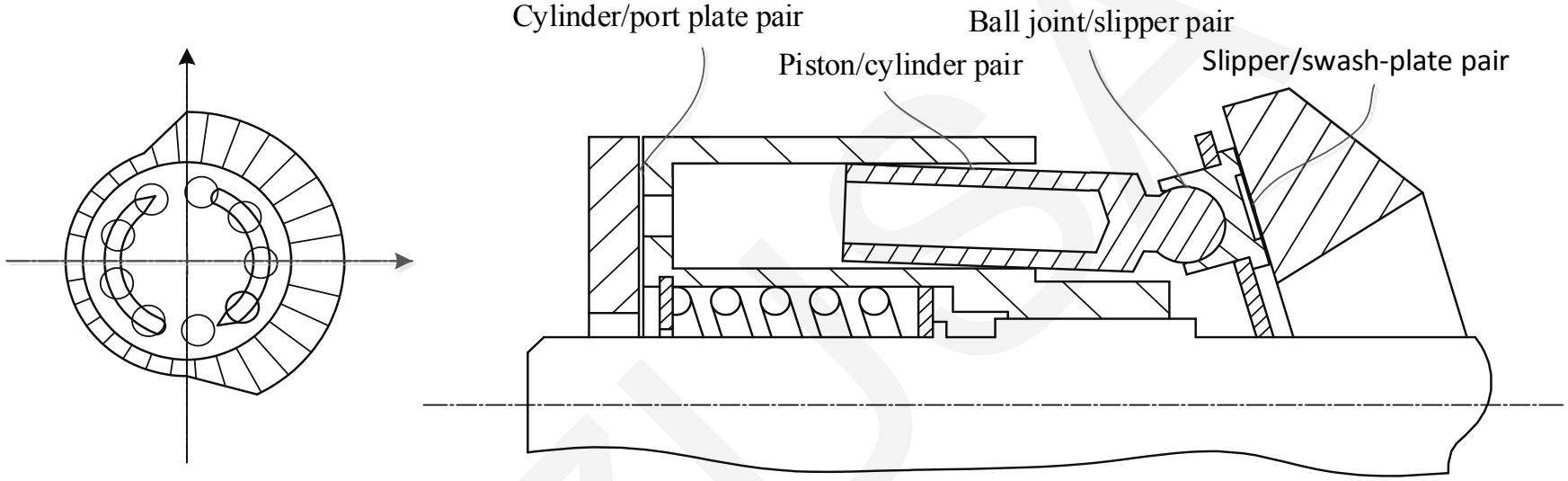
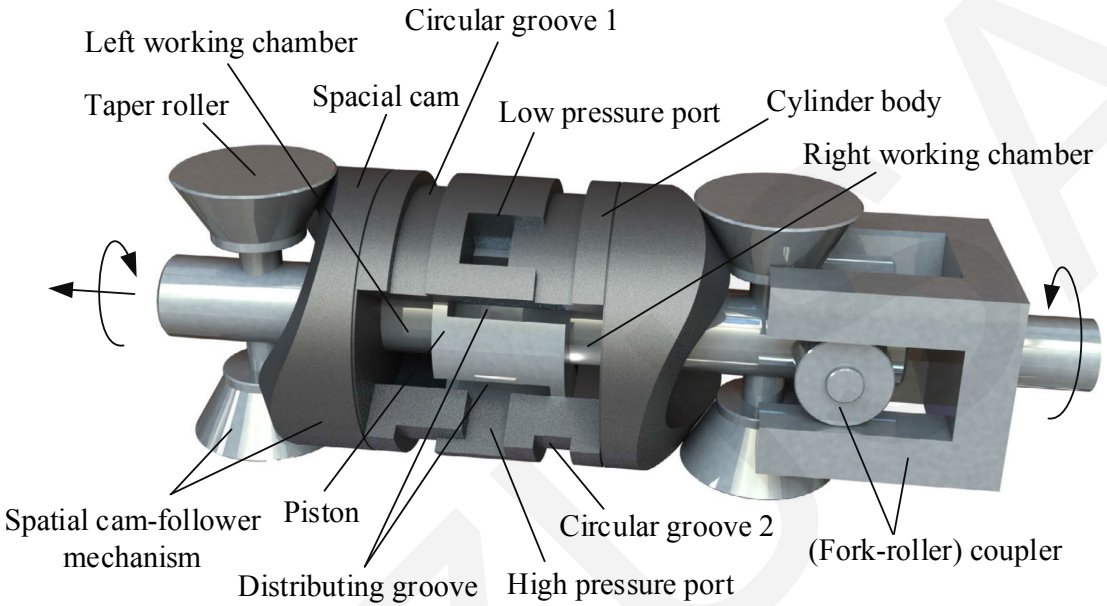
Conventional axial piston pump



characteristics :

1. Three main friction pairs
2. Force unbalanced
3. Contradiction between lubrication and leakage
4. Structural flow ripple

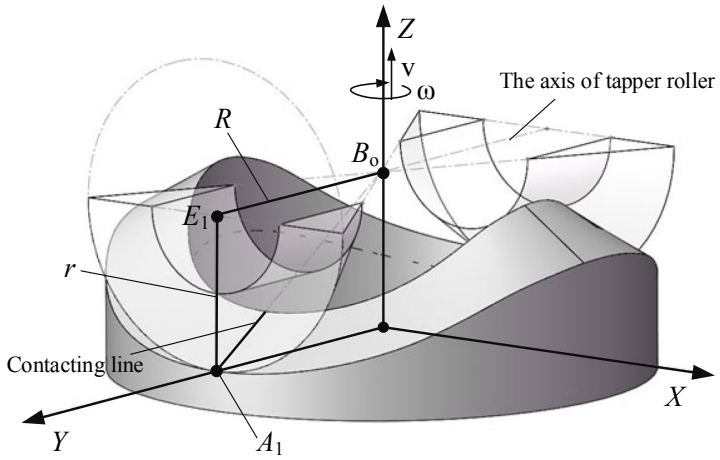
Two-dimensional piston pump

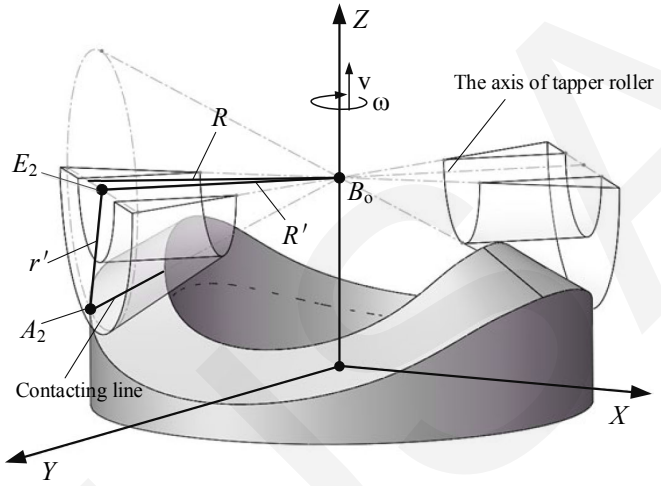


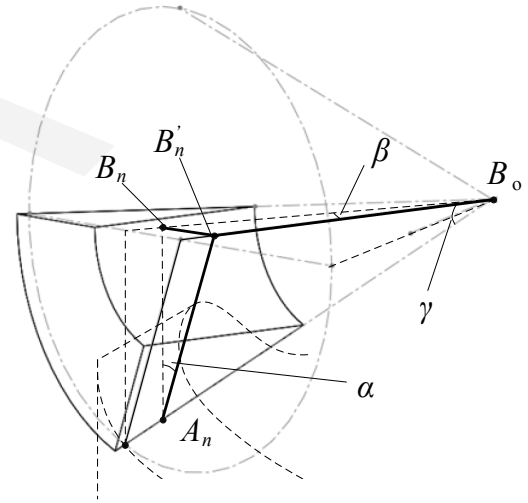
characteristics :

1. Two main friction pairs
2. Force balanced
3. Inexistence of contradiction between lubrication and leakage
4. Inexistence of structural flow ripple

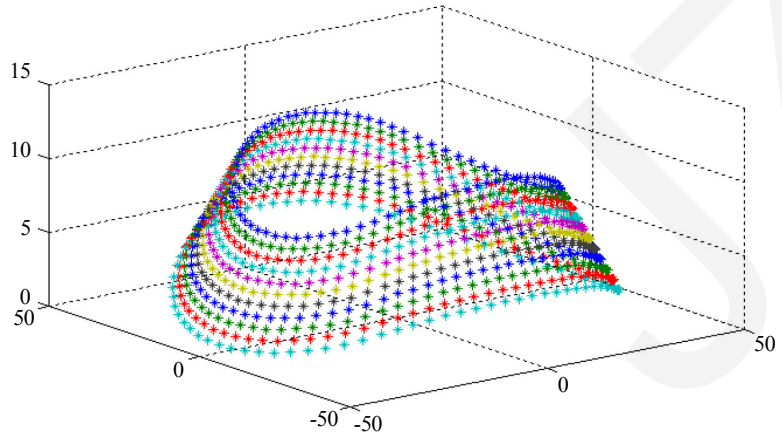
Mathematical modelling of the cam surface

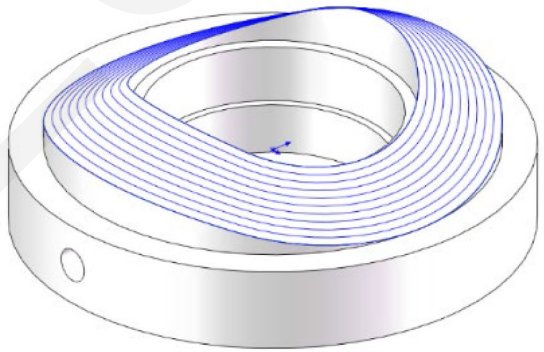




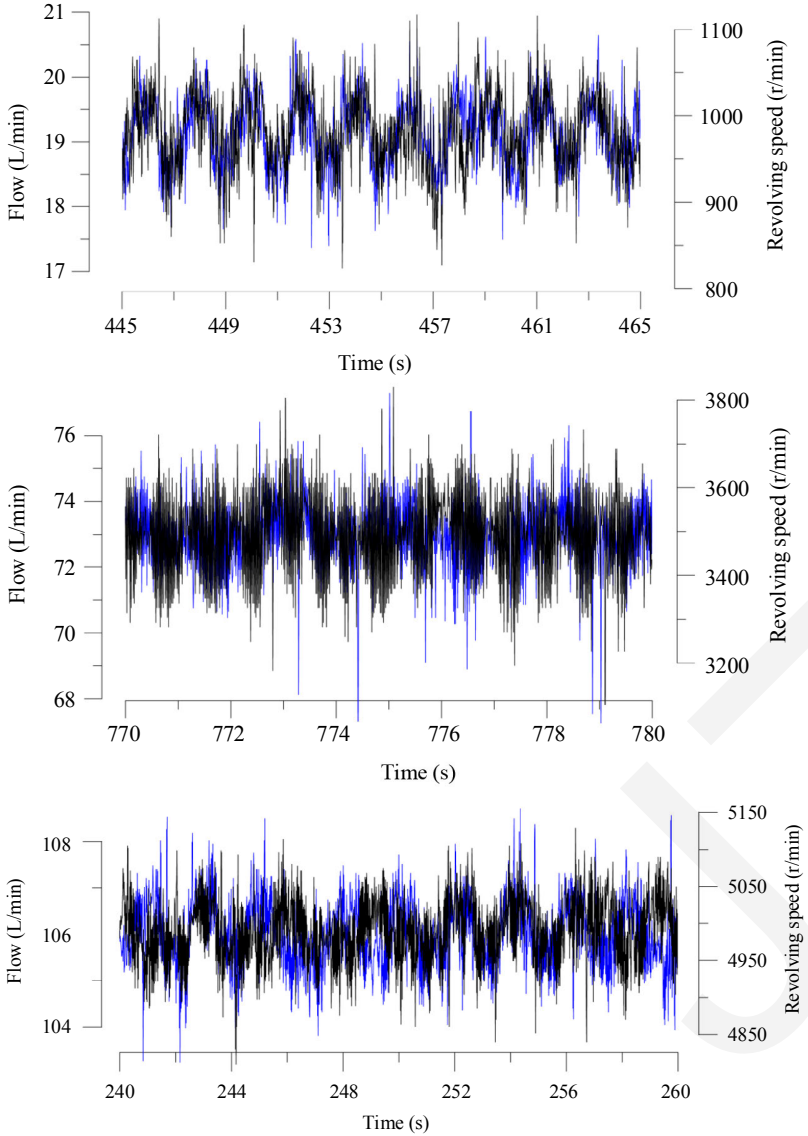


Establish the mathematical model of the cam surface to guide the design and machine of the cam

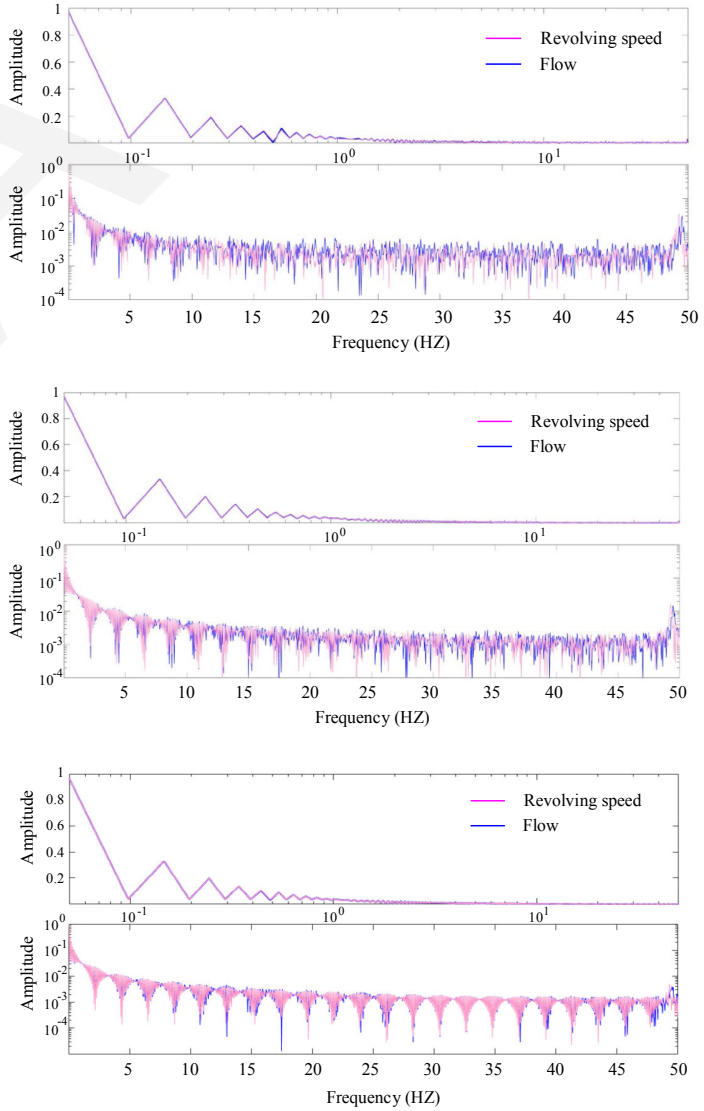




relationship between flow and revolving speed



frequency spectrogram of the two curves



Results and conclusions

A novel pump design which is highly integrated and force-balanced without structural flow pulsation was proposed and the principle was illustrated.

The spatial cam-follower mechanism as a vital part of the novel pump was prototyped and analyzed. A universal mathematical model of the contacting surface in the roller-cam rail mechanisms was constructed and calculated in the Matlab program. Then the precision of the cam was contrasted with the sample manufactured in the Geomagic program and verified through the motion test of the piston.

Then the no-load flow characteristics of the tandem pump were tested by analyzing the frequency spectrogram of the curves of flow and revolving speed. The clutter in the curve is considered mainly to originate from the fluctuation of the revolving speed.

Both the theoretical analysis and experimental results indicate that the surface of the cam rail is precise and the two-dimensional pump has the potential advantage of eliminating sliding friction pairs and structural flow ripple.