An analysis of characteristic of a pneumatic cylinder in intelligent prosthesis

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ABSTRACT
In this study, an experiments and numerical simulation of a three chamber pneumatic cylinder for an intelligent AK-knee prosthesis is performed. The cylinder has a variable orifice which can be controlled automatically through a microprocessor controller as needed while amputee gait. In the experiment, the cylinder was driven by a cam whose trajectory simulates the normal gait, and axial forces of cylinder with different orifice opening was measured. The numerical simulations was based on thermodynamic and fluid mechanical consideration. The experimental results and the numerical results were in good agreement.

Introduction

A technique of artificial joint using artificial organs that is compatibility with human body. The artificial joint is driven by controlling the fluid pressure and the valve movements. In this study, a three-chamber pneumatic cylinder was used to control the fluid pressure and the valve movements. The cylinder has a variable orifice which can be controlled automatically through a microprocessor controller as needed while amputee gait. In the experiment, the cylinder was driven by a cam whose trajectory simulates the normal gait, and axial forces of cylinder with different orifice opening was measured. The numerical simulations was based on thermodynamic and fluid mechanical consideration. The experimental results and the numerical results were in good agreement.

Methods

The experiments were conducted using a three-chamber pneumatic cylinder. The cylinder has a variable orifice which can be controlled automatically through a microprocessor controller as needed while amputee gait. In the experiment, the cylinder was driven by a cam whose trajectory simulates the normal gait, and axial forces of cylinder with different orifice opening was measured. The numerical simulations was based on thermodynamic and fluid mechanical consideration. The experimental results and the numerical results were in good agreement.

Results

The experimental results were compared with the numerical results. The experimental results were in good agreement with the numerical results. The agreement was better for the lower orifice opening.

Conclusion

The results of this study show that the three-chamber pneumatic cylinder is useful for the artificial joint. The cylinder has a variable orifice which can be controlled automatically through a microprocessor controller as needed while amputee gait. In the experiment, the cylinder was driven by a cam whose trajectory simulates the normal gait, and axial forces of cylinder with different orifice opening was measured. The numerical simulations was based on thermodynamic and fluid mechanical consideration. The experimental results and the numerical results were in good agreement.

References


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상태까지 공압 실린더내의 피스톤이 하향진행하며 실린더하부의 나들볼브를 통해 유체가 하부챔버에서 수 있게 되었다.

Fig. 1 A schematic diagram showed operation process of the pneumatic cylinder

상부챔버로 이동한다. 이때 Fig.2와 3에 보는바와 같이 축력이 최대에 이르는 시점을 지나 1차노즐의 절

랑유량도 크게 증가한다. 설계값에 신경을 쏟아 피스톤은 상향진하며 상하챔버사이에 압력이 평형을 이루어 C상태를 지나 상부챔버의 압력이 커지는에게 실린더의 체크밸브는 서서히 닫히고 피스톤의 체크밸브가 열리면서 유체는 2차노즐을 통해 상부챔버에 하부챔버로 이동하게된다. 이 상태에서 보행속도에 따라 극격히 신체가 일어나며 유각기 보행이 거의 종료될 때 발뒤극 절지시 매우 부자연스런 보행을 이루게된다. 이를 방지하기 위해 D상태에 이르

면 속도저감 장비(실린더 상부에 제3의 체크)가 형성 되어 상부챔버의 공기는 3차노즐을 통하여 제3의 체

크로 되어며 Fig.2의 D-E 구간의 저항압력이 생성된다. 이 힘은 극격한 신체(C와D사이 구간)에 대한 등동작용으로 작용하며 보행의 발뒤극 절지 전 의지의 응직임을 부드럽게 유도할 수 있다. Fig.2는 보행시간에 대한 축력의 변화로 시뮬레이션과 실험 결과 사이의 오차가 거의 없이 같은 경향을 나타내고 있다. Fig.2는 체크밸브의 용량변화와 함께 실린더내의 유체의 효율을 얻으며 각 노즐의 설계 및 간극조절을 수치적으로 미리 판단할 수 있는 자료로 활용될 수 있다.

결론
인공지능의지능 보행실린더의 개발은 경상인의 유각

기 보행패턴을 모사한 컴퓨터를 통한 상상실험과 수치 모델링을 이용한 실험결과를 비교하였다.

1. 인공지능의지능 보행실린더의 속도저감장치(체크

와 3차노즐)는 보행속도에 따라 발뒤극 절지시 하지

의 극격한 신체를 방해함을 알 수 있다.

2. 실험과 수치해석결과 보행시간에 따라 유사한 축력

을 나타내었다.

3. 보행에 따른 실린더내의 압력변화, 설량변화등을

구하여 실린더 제작 전 노즐형태 및 간극을 설계할

Fig. 2 Comparison of axial forces cylinder.

Fig. 3 Mass flow rate through each nozzle of 3 chamber model.

참고 문헌


