A Study on the analysis of static and dynamic characteristic of fusion reducer module

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Abstract: - The fusion reducer module increases the torque of the motor in the robot system, and converting rotational motion into linear motion or a linear motion to rotational motion. The fusion reducer module part is a robot system to determine the final motion performance. Features of the reducer module for the latest robots are the main influence factors reducer weight directly connected with the base load of the platform for manufacturing the robot. The features of the development fusion reducer module is to implement the cycloid or planetary motion in a rotary motion to place a different component in the internal system components to planetary motion and coupled cycloid motion. This paper contains the dynamic Analysis, natural frequency analysis, static Analysis of development reducer module.

Key-Words: - Fusion reducer module, Dynamic, Static, Natural frequency, Analysis, Cycloid

1 Introduction

This development fusion reducer module is easy to apply to thin-lightweight equipment can reduce the installation height because it has a simple structure. It can reduce the use of the complex as a conventional around accessories. The frequency of the maintenance work can be achieved to improve productivity because it significantly reduce than before.

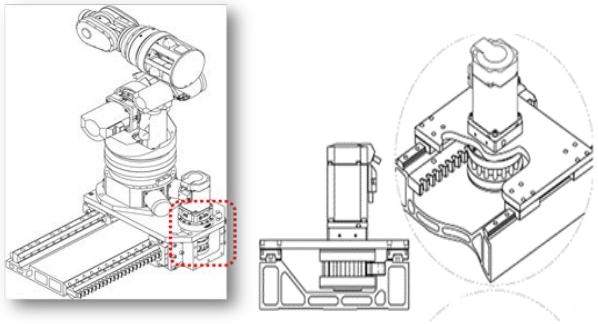


Fig. 1 The fusion reducer module for robot system

The reducer module structure can be reduced because the height of the roller devices has a structure to interact with a rack that is intensive assembly to the main frame. Reducer module has a simplified structure to induce a rotational motion of the rollers relative to each other in association with the power transmission of the planetary gear is positioned within the device.

This is fusion reducer module specs of this development.

- Standard length: 960 mm
- Reduction ratio: 1/49
- Rating torque: **2**30 Nm
- Linear feed speed: 3m/s
- No. of roller: 16 ea
- Pressure angle: 19 deg

2 Dynamic analysis of reducer module

In order to investigate the operability of main core component of the rack and pinion of the fusion reducer module were used to multi-body dynamics Multi-body dynamics is relative motion and the force field of the study of the object in the case of the configuration of one or more objects that movement keeping the mutual relationship.

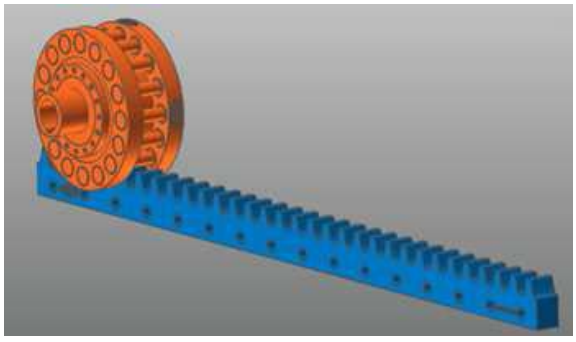


Fig. 2 Multi-body dynamics analysis model

Fig 2 is a multi-body dynamics analysis model for analyzing the dynamic behavior of reducer module rack and pinion. Following figure is the mechanism system of the translation of the rack at a speed 3m / sec. Fig 3 shows the total distance moved for 0.5 seconds when the rack moves at a speed of 3 m / sec.

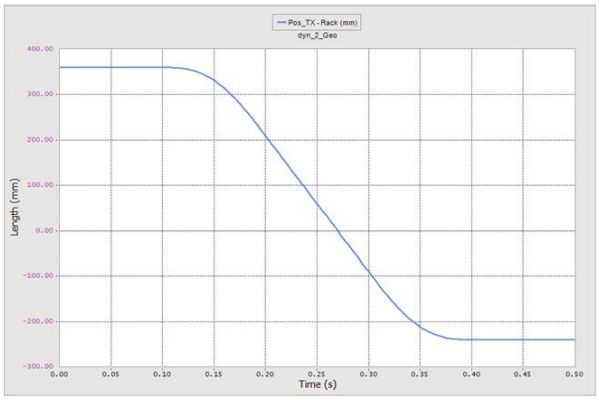


Fig. 3 Analysis result of displacement of rack gear translation

Fig 4 shows the acceleration for the moving rack for 0.5 seconds. This figure is a rack rate of speed results appear in the 0.5 m / sec. The same output speed and input speed of 0.2 m / sec was calculated. Through this, is was verified reliability of the object dynamics analysis. We have studied the operating performance and response speed of the rack and pinion according to various load loads.

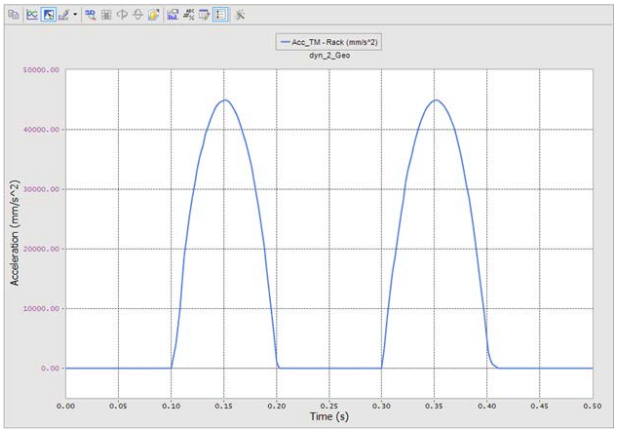


Fig. 4 Analysis result of acceleration of rack gear

We performed the analysis under the condition that the initial torque of the pinion was 342,000 Nmm, which is the maximum allowable reducer torque. Fig 5 and 6 show the rotational speed and acceleration results of the same pinion. As shown in the results, when the rack and the pinion move, the vibration occurs due to the discontinuity of the gear toothing.

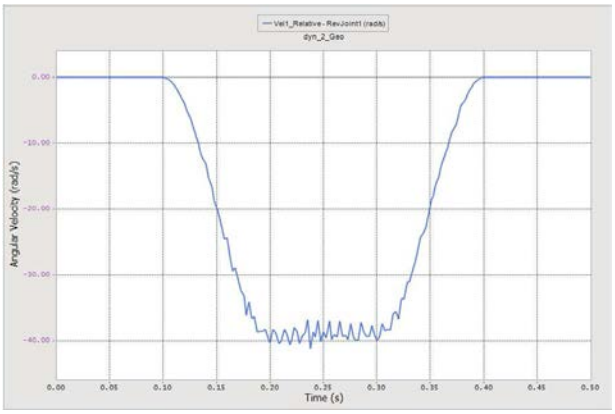


Fig. 5 Analysis result of angular velocity of pinion gear

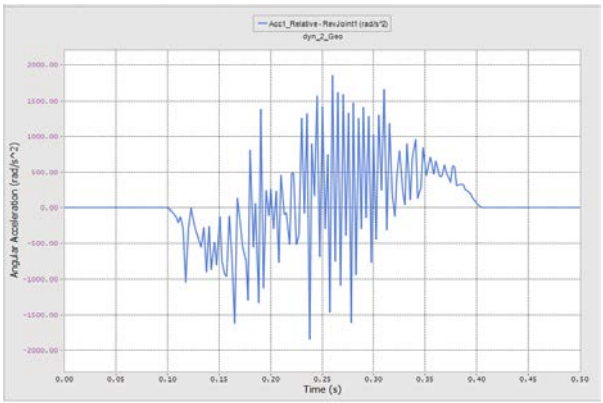


Fig. 6 Analysis result of angular acceleration of pinion gear

Fig 7 shows the amount of contact force generated at the pitch point of the gear and pinion gear of the rack according to the translational movement of the rack over time.

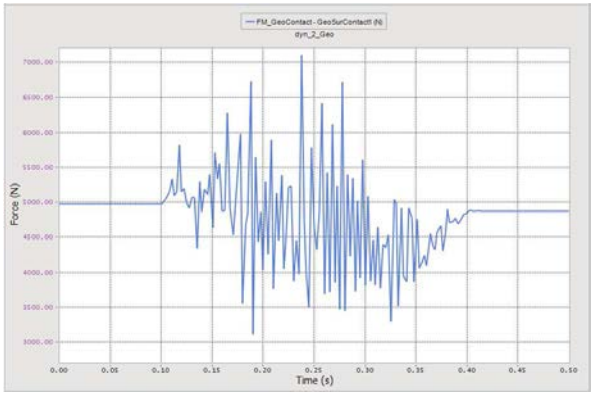
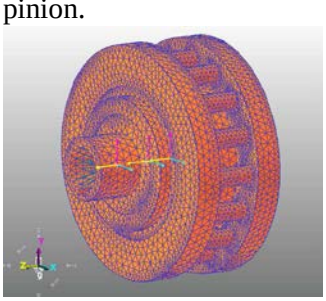


Fig.7 Analysis result of contact force at the pitch point of the gear and pinion gear of the rack

3 Natural frequency analysis of reducer module

In this study, a numerical method called FEM was used to characterize the natural frequencies of the gears of the reducer module rack and the pinion. Fig 8 are mesh models for the finite element method calculating and the three-dimensional CAD shape of the rack and pinion.



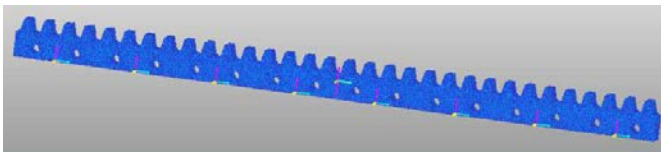


Fig.8 Mesh model of the rack and pinion for analysis

We analyzed the natural frequency characteristics of the rack and the pinion by performing a natural vibration analysis on the rack and the pinion, respectively. This is an analysis to predict the resonance of the reducer module and the shape of the deformation due to vibration. If the natural frequency of the reducer module itself and the operating frequency of the external load coincide, a resonance occurs in the reducer module. When resonance occurs in a structure, vibrations and noise suddenly increase, and ultimately, the structure may be destroyed.

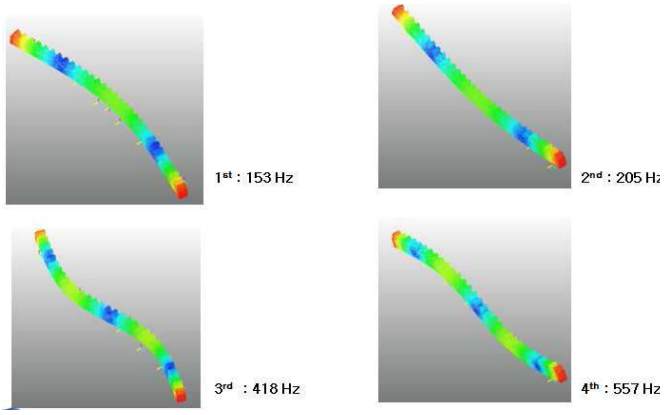


Fig.9 Analysis result of natural frequency of rack gear

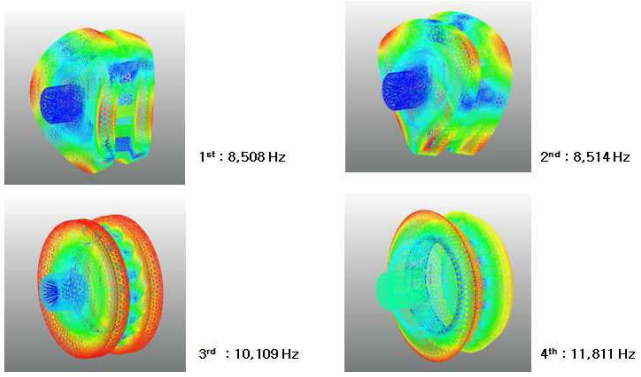


Fig.10 Analysis result of natural frequency of pinion gear

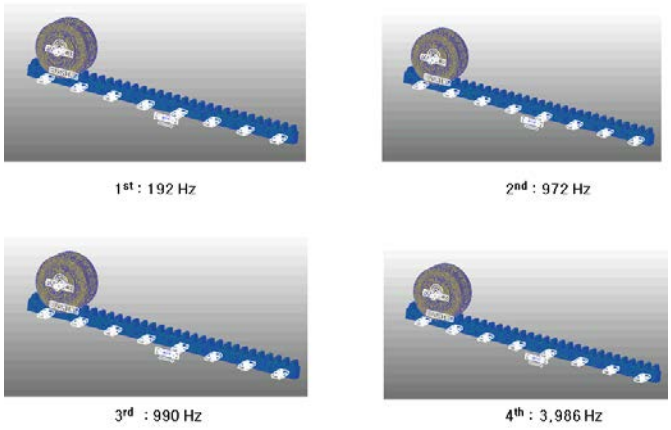


Fig.11 Analysis result of natural frequency of rack and pinion gear

4 Static analysis of reducer module

In this study, to find out the strength and rigidity characteristics of the reducer module gear racks and pinion used the finite element method. Finite element analysis was used to calculate the stress in the rack and pinion gear.

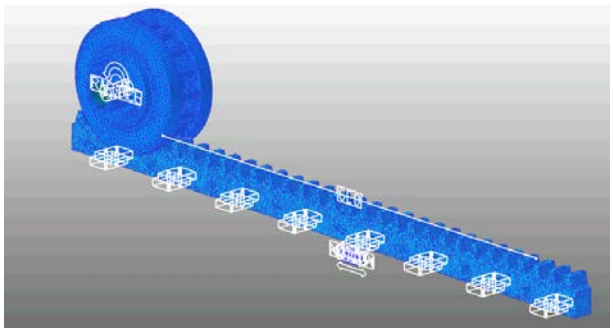
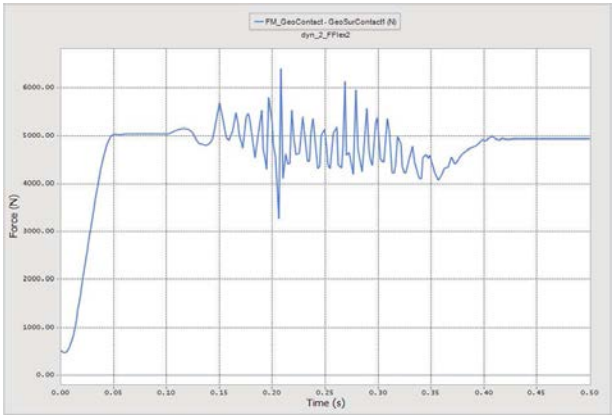
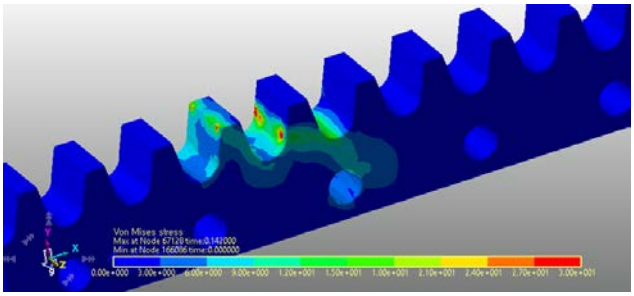


Fig. 12 Analysis lattices of rack & pinion

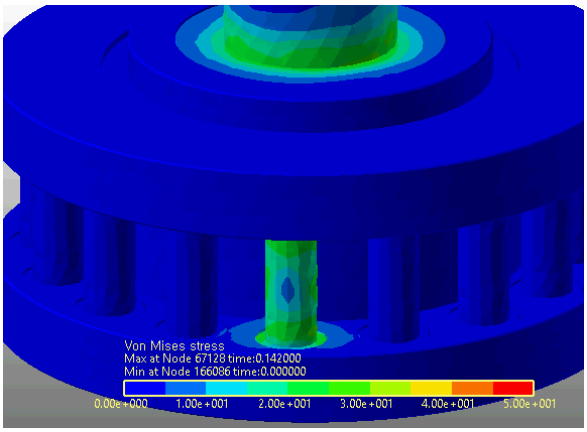
The reducer module design strength of tooth are reviewed mainly on the tooth root bending strength and fatigue strength of tooth contacts. It is this thickness at the root which has the greatest influence on its bending strength. It is this thickness at the root which has the greatest influence on its bending strength. This bending strength is taken into consideration for the distribution of the teeth of a pair of gears in selecting the profile shifted coefficient of the profile shifted gear.



(a) Contact force between rack and pinion



(b) Stress analysis result of rack



(c) Stress analysis result of pinion

Fig.13 Analysis results of stress

Fig 12 show the results of calculating the stress in the rack and pinion. At the analysis results in is rack and pinion has a sufficient strength, it can be seen that satisfies the strength safety of reducer module.

5 Conclusion

This study relates to a fusion reducer module for implementing a light weight, thin integrally built-in reducer the development module. This paper contains the dynamic Analysis, natural frequency analysis, static Analysis of development reducer module. In conclusion, it was known the design dynamics and strength of reducer module are adequate design through analysis.

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