contacting the ends of the four lead screws, with the slots on both sides of the SSMP. While arriving at scheduled orbit, four lead screws on each side are then driven inversely to release the SSMP.

The L/R mechanism with imperfect manufacturing quality results in two problems: firstly, inaccurate location and transmission of any lead screw would cause the contact backlash between the SSMP and each lead screw. It tends to raise impact damage structurally by harmonic response of the SSMP's vibration during the launch stage; Secondly, the unbalanced locking supports on the SSMP inversely make lead screws unable to form symmetric or regular deformation, which also poses a potential threat to the shuttle structurally. However, higher manufacturing accuracy for the L/R mechanism would inevitably increase manufacturing complexity; it may be unreachable to manufacturing capability. Therefore, an optimum compromise between tolerance and capacity for the mechanism is essential to vouch the system's high reliability and security.

3 Modelling and simulation

Geometrical errors of the L/R mechanism come from the uncertainty of connected components' position and orientation during the manufacturing stages, and complicate the influence of the output errors, which are represented by the end errors of the lead screws. In this section, an accuracy model of the L/R mechanism using vector differential algorithms is established, which provides linear relations between geometrical errors and output errors. On improving accuracy simulation precision and efficiency, the Halton-set based MC simulation is introduced and compared to the traditional pseudo-random set based MC simulation.

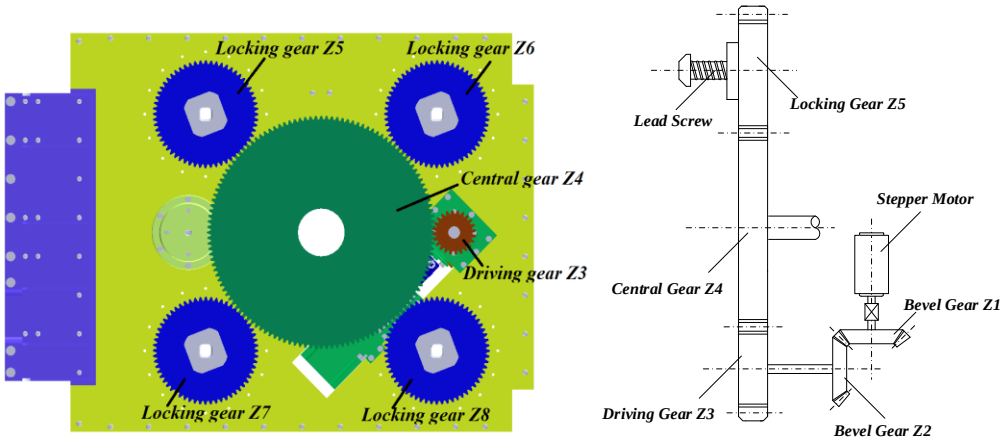

Figure 3. Configuration of transmission train of the L/R mechanism.

3.1 Mechanism accuracy modeling

Both the L/R mechanisms are symmetrically configured on both sides of the SSMP as shown in Fig. 1. Each side can provide enough geometric information for accuracy analysis. Four lead screws are fixed on the backplane of the L/R mechanism, and they are guided by a gear train to synchronously travel forward until their ends contact slots of the SSMP on a side.

The imperfectness of assembly generates locational errors δx_p, δy_p, δz_p, $\delta\alpha$, $\delta\beta$ and $\delta\gamma$ of the backplane, they are with respect to the nominal position of the scientific research experiment rack; similarly, each lead screw on the backplane has locational errors δa_{ix}, δa_{iy}, δa_{iz}, and angular errors δu_{ix} and δu_{iy} about x- and y- axes. The axial error δl of each lead screw is theoretically contributed by transmission errors from the engaged gears and assembly error. However, repetitive experiments had indicated the axial error of lead screw assembled weighted majority among the translation errors, therefore, the transmission errors are not included in the mechanism accuracy model. The output errors δb_{ix}, δb_{iy} and δb_{iz} refer to inaccuracy between the end of each lead screw and nominal contact center on a side of the SSMP.