This is the peer reviewd version of the followng article:

Symmetry breaking and chaos-induced imbalance in planetary gears / Masoumi, Asma; Pellicano, Francesco; Samani, Farhad S.; Barbieri, Marco. - In: NONLINEAR DYNAMICS. - ISSN 0924-090X. - STAMPA. - 80:1-2(2015), pp. 561-582. [10.1007/s11071-014-1890-3]

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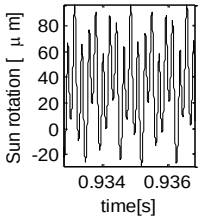
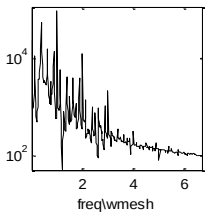
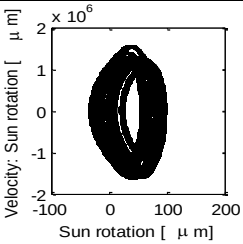
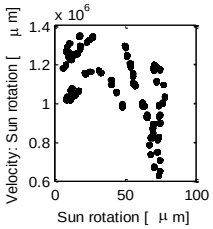
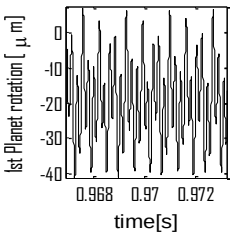
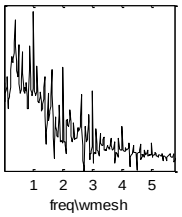
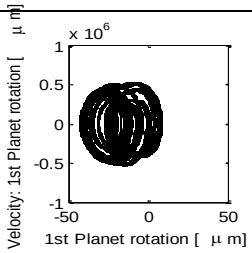
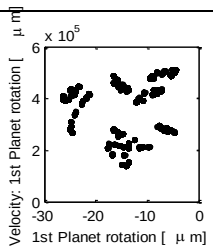
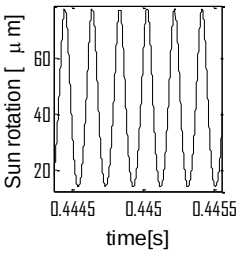
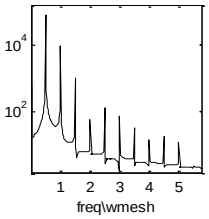
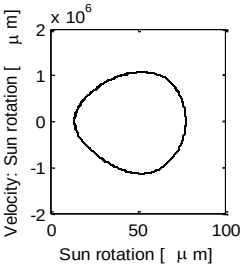
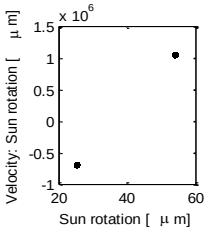
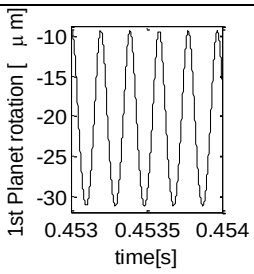
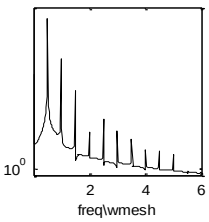
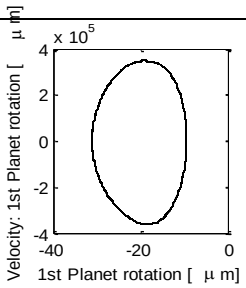
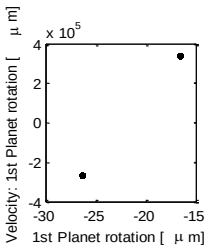
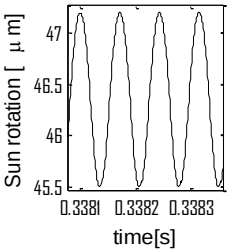
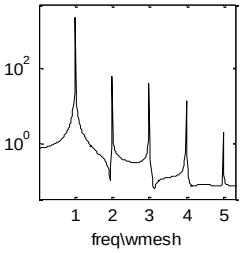
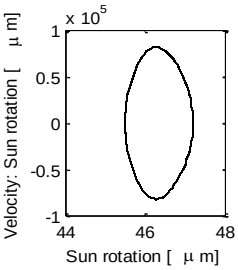
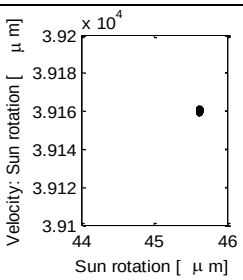
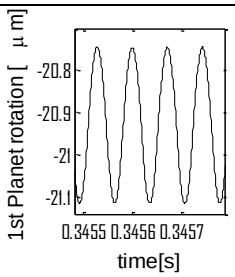
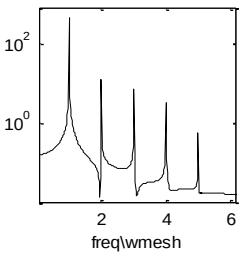
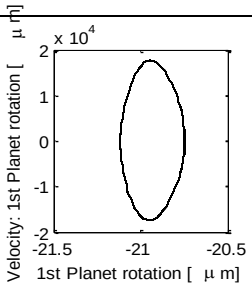
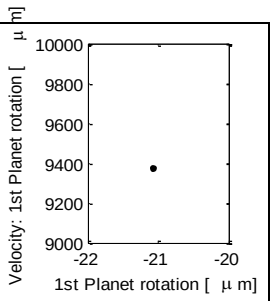
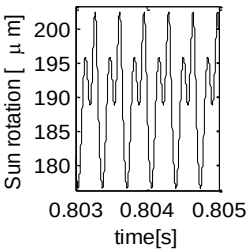
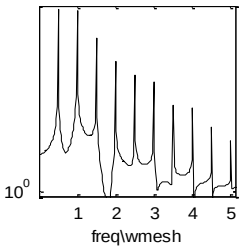
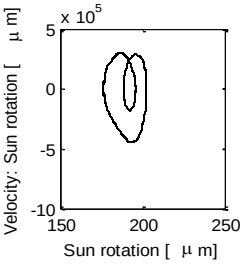
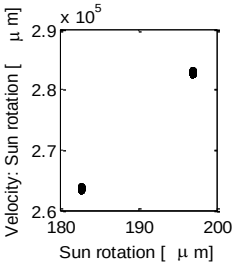
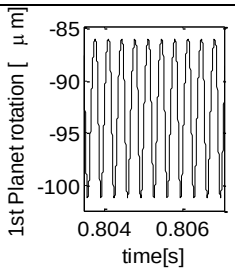
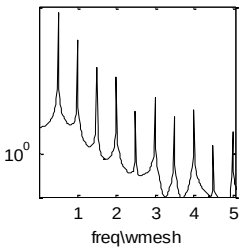
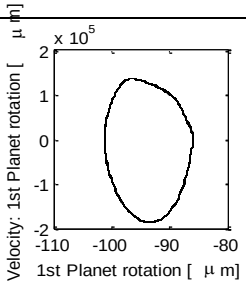
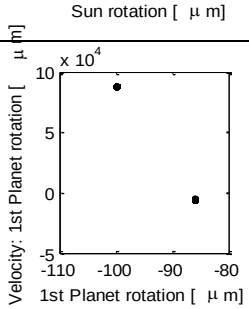
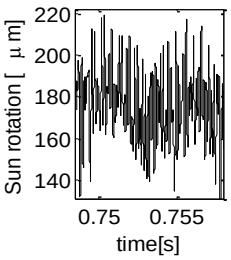
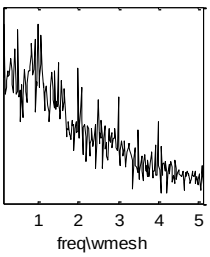
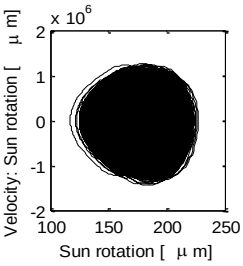
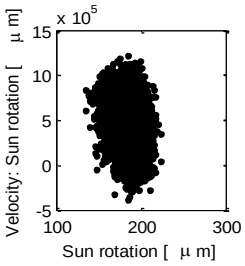
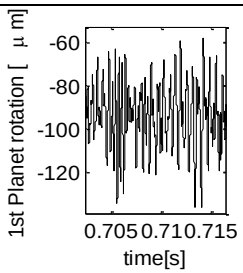
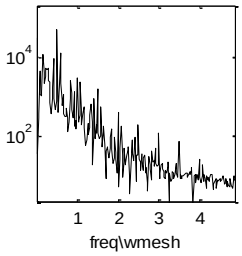
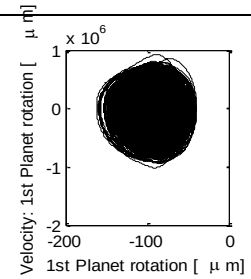
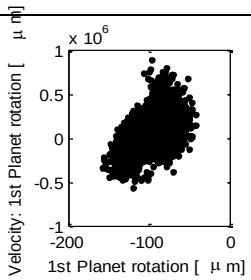
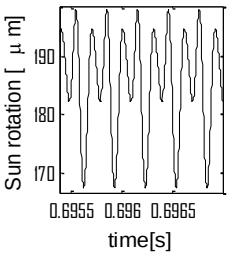
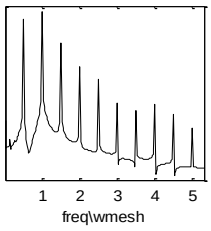
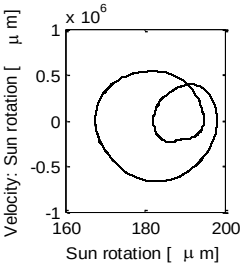
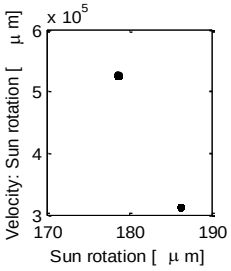
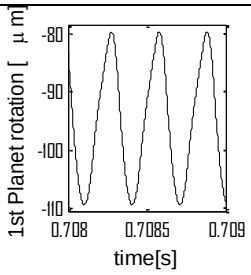
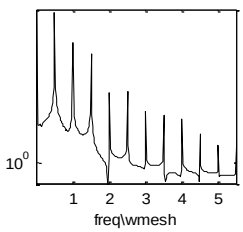
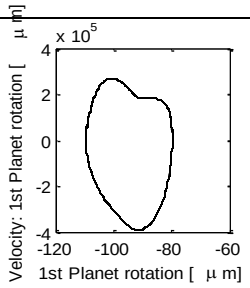
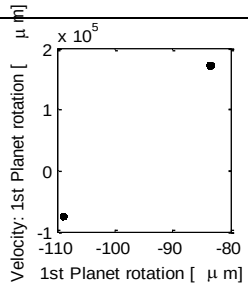
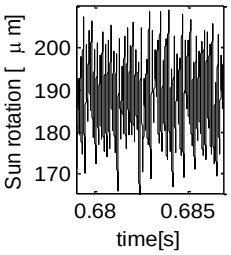
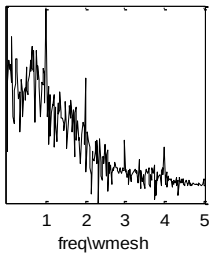
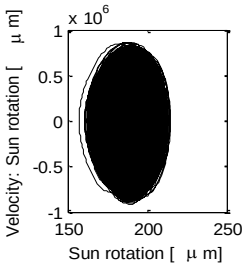
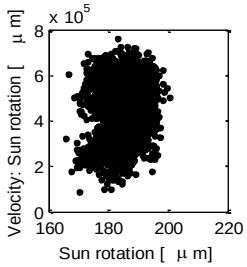
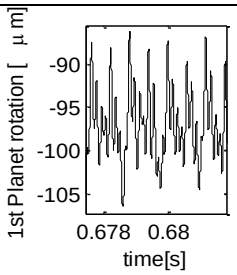
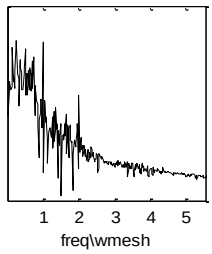
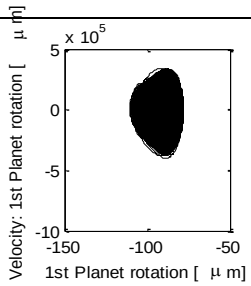
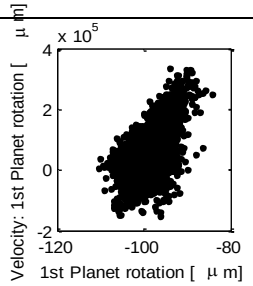
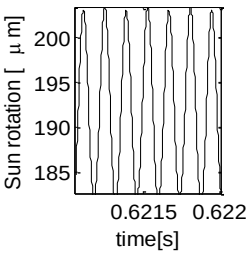
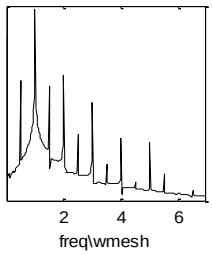
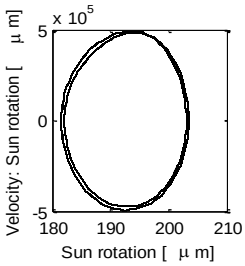
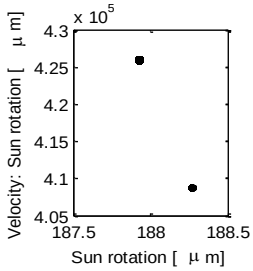
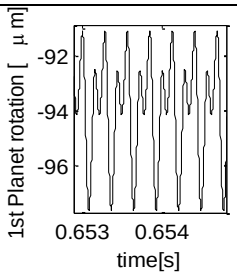
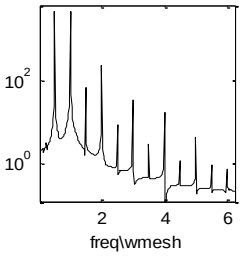
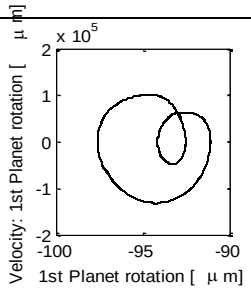
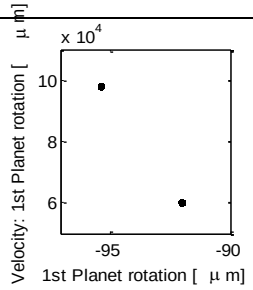
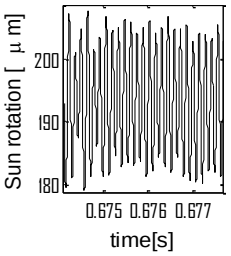
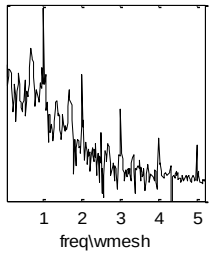
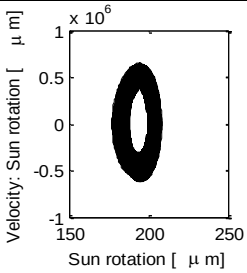
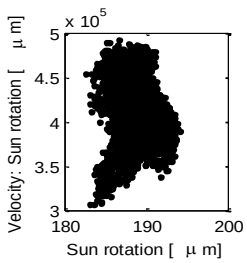
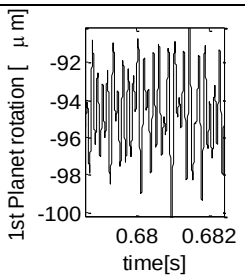
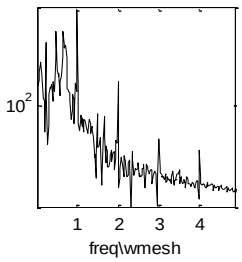
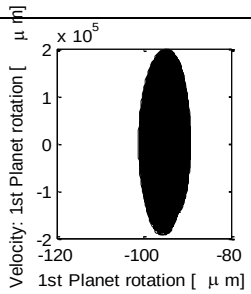
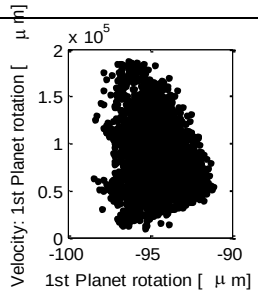
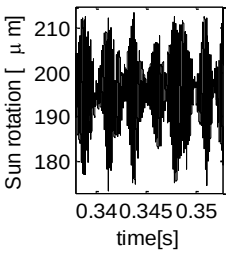
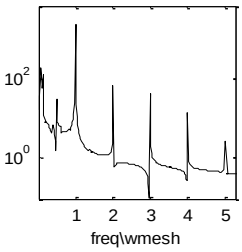
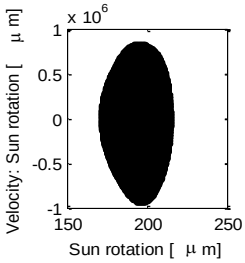
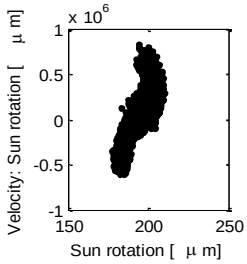
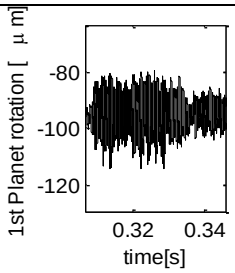
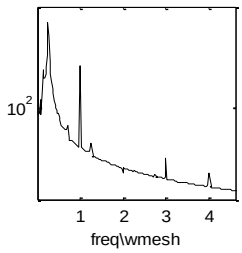
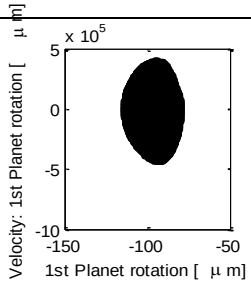
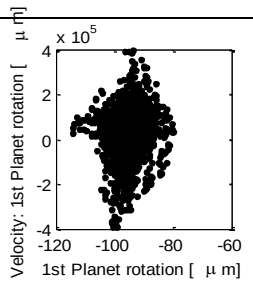
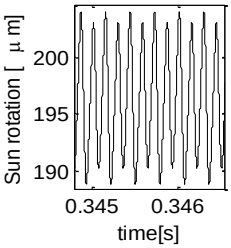
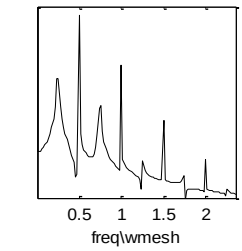
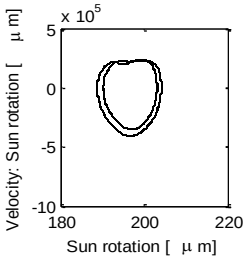
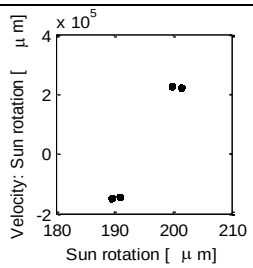
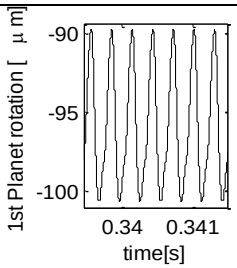
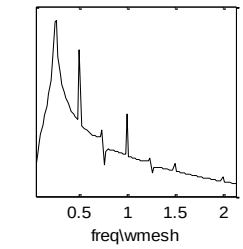
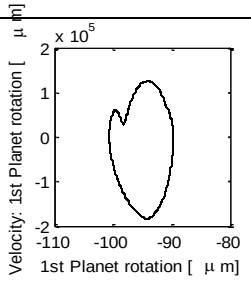
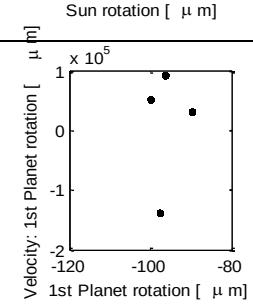
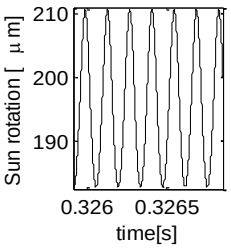
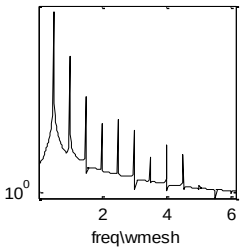
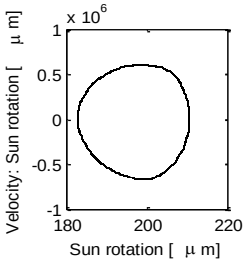
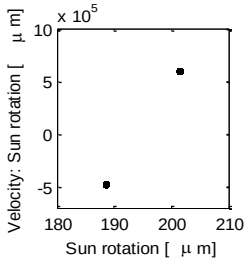
(Article begins on next page)

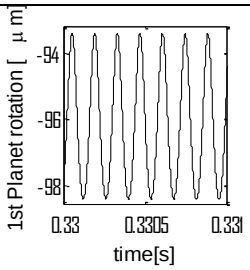
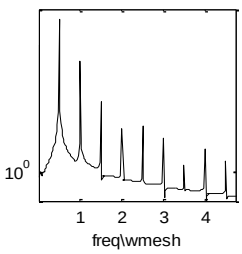
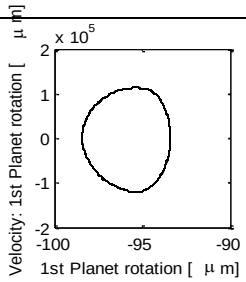
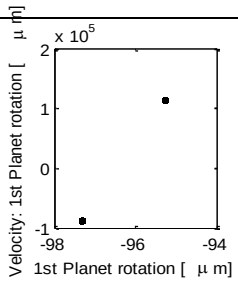
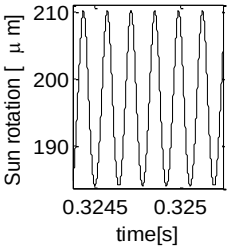
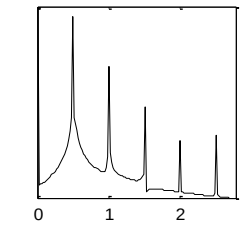
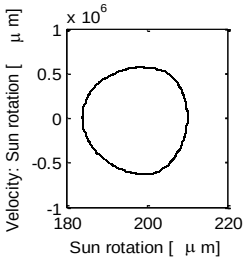
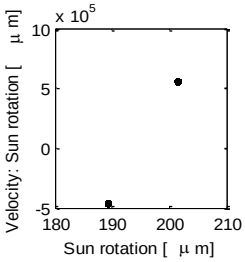
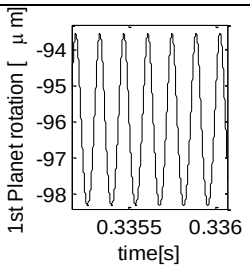
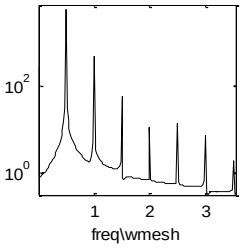
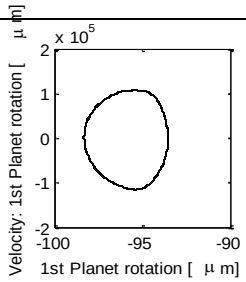
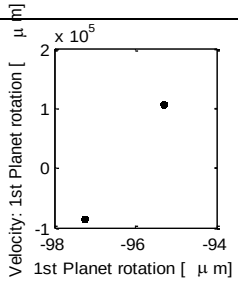
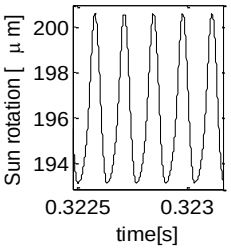
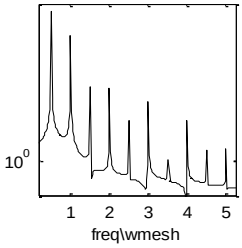
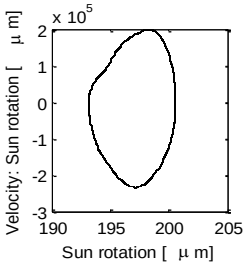
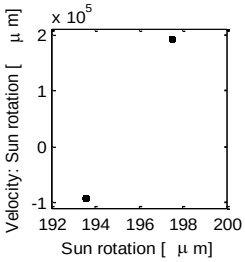
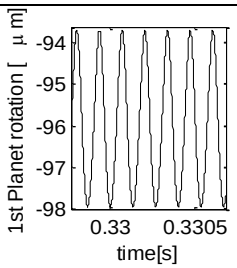
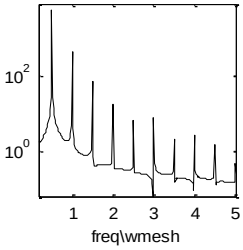
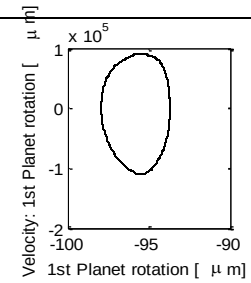
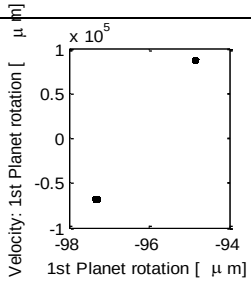
Table 9: Analysis of specific regimes: phase portraits, Poincaré maps, time histories and spectra

Description	Time history	Spectrum	Phase-portrait	Poincaré map
Case 1 4682 Hz Sun Rotation				
Case 1 4682 Hz 1st Planet Rotation				
Case 1 10290 Hz Sun Rotation				
Case 1 10290 Hz 1st Planet Rotation				
Case 1 14000 Hz Sun Rotation				

Case 1 14000 Hz 1st Planet Rotation				
Case 2 5850Hz Sun Rotation				
Case 2 5850Hz 1st Planet Rotation				
Case 2 6107 Hz Sun Rotation				
Case 2 6107 Hz 1st Planet Rotation				
Case 2 6598 Hz Sun Rotation				

Case 2 6598 Hz 1st Planet Rotation				
Case 2 6808 Hz Sun Rotation				
Case 2 6808 Hz 1st Planet Rotation				
Case 2 7112 Hz Sun Rotation				
Case 2 7112 Hz 1st Planet Rotation				
Case 2 7182 Hz Sun Rotation				

Case 2 7182 Hz 1st Planet Rotation				
Case 2 13420 Hz Sun Rotation				
Case 2 13420 Hz 1st Planet Rotation				
Case 2 14000Hz Sun Rotation				
Case 2 14000Hz 1st Planet Rotation				
Case 2 14290Hz Sun Rotation				

Case 2 14290Hz 1st Planet Rotation				
Case 2 14500 Hz Sun Rotation				
Case 2 14500 Hz 1st Planet Rotation				
Case 2 14940 Hz Sun Rotation				
Case 2 14940 Hz 1st Planet Rotation				

At 4682 Hz (Case 1), the dynamics appear complex, time histories appear non-stationary as well as the spectrum is dirty; however, the Poincaré map shows a scenario between quasi-periodic and strongly subharmonic; i.e. the distribution of points seems to lie on a continuous curve (typical of quasi-periodic), but the points are positioned in discrete locations.

At 6107 Hz (Case 2), the gearbox experiences chaotic motion, the time histories and spectra are irregular; the phase trajectory fills a portion of phase space and the Poincaré map appears fractal.

At 6808 Hz (Case 2), there is probably a low dimensional chaos, as a specific harmonic is prevalent in the spectrum.

As we have mentioned above and from Table 8 is also clear at frequency range $\omega_m \in$(13400-13800) Hz, there is another chaotic region which leads to 4T region at the frequency range $\omega_m \in$(13800-14200) Hz. A further 2T region, appears for $\omega_m \in$(14200-14800) Hz. It seems that here the route to the chaos is a cascade of period doubling. (see Fig. 8)