Another Possible Cause of AA587 A300-605R Accident

July 18, 2005

This brief report is prepared to explain the possibility that the inertial forces on the control linkages moved control surfaces, or at least influenced very much on pilot's control feel forces on AA587 accident.

This hypothesis also could be the common root cause of other A300-600R and A310 upset incidents, although stringent quantitative examination has to be done.

LOCAL LOAD FACTOR

The load factor far from CG (Center of Gravity) is much different from the load factor at CG when the attitude of the aircraft is changing rapidly.

Figure 1 is the normal load factor at tail, and Figure 2 is the lateral load factor at tail. Tail position is assumed 23 meter aft of CG. Flight data and calculation method are based on Ref. [1]. Both normal and lateral load factors at tail are fluctuating very much.

Figures 3 thru 5 are the three axis load factors at aileron. Aileron position is assumed 7 meter right or left of CG. Reciprocating longitudinal load factors are noteworthy.

INERTIAL FORCE ON CONTROL LINKAGE

Figure 6 from Ref. [1] shows the control positions and calculated control forces. Comparing the local load factors with Figure 6, one could find out many correlations.

How the local load factors could be related to inertial forces on control linkages and their movements are illustrated in figures 7 thru 9. For simplicity, only main cause and result are illustrated.

If these inertial forces are added while the pilot is controlling manually, normal control would become very difficult or even impossible because the column, the yoke and the pedal move by themselves, or the feel forces become much different and time varying.

To calculate these inertial forces exactly, the mass property, dimension and location of every part of the control linkage must be examined.

CHAIN OF EVENT

The aircraft dynamics and control linkage dynamics are intricately related. They are illustrated in figures 10 and 11. It is suggested that the pitch-yaw-roll near self-induced oscillation kicked off by wake encounter was mostly what happened on AA587 accident.

Although there might be some minor error in this report, this hypothesis would be helpful for seeking the true cause of the accident.

REFERENCES

[1] NTSB "Aircraft Performance Group Chairman's Aircraft Performance Study", Oct.10, 2002

[2] NTSB "Systems Group Chairman's Factual Report of Investigations", Sept.23, 2002

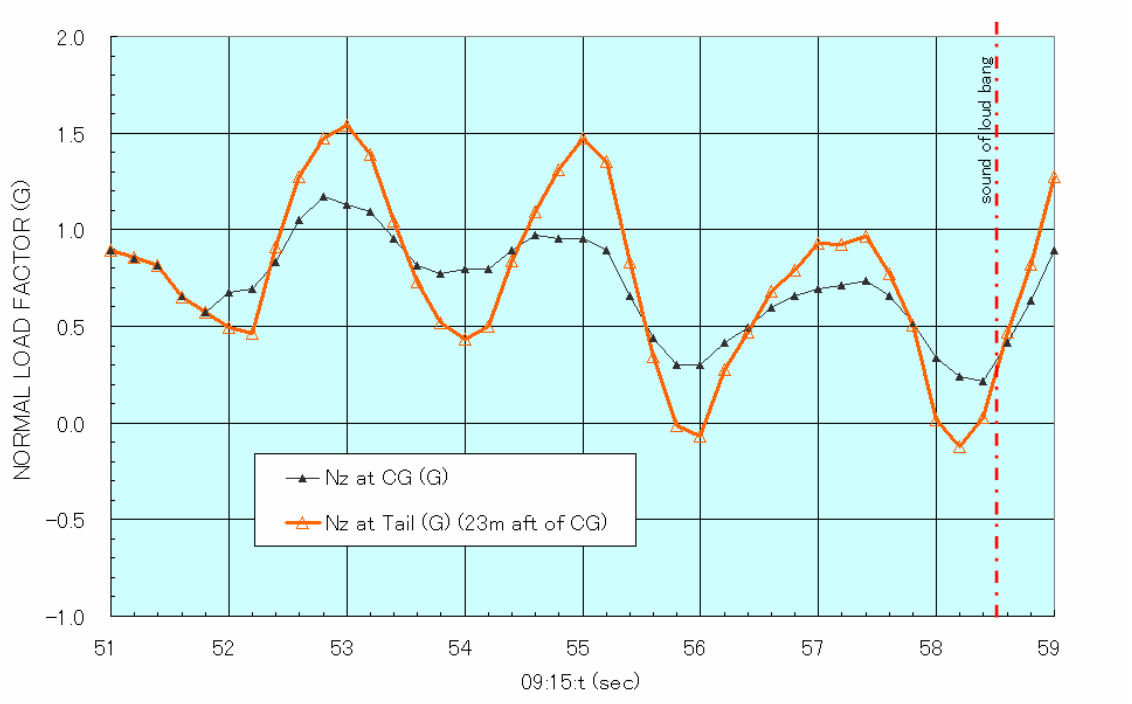

Fig. 1 Normal Load Factor at Tail

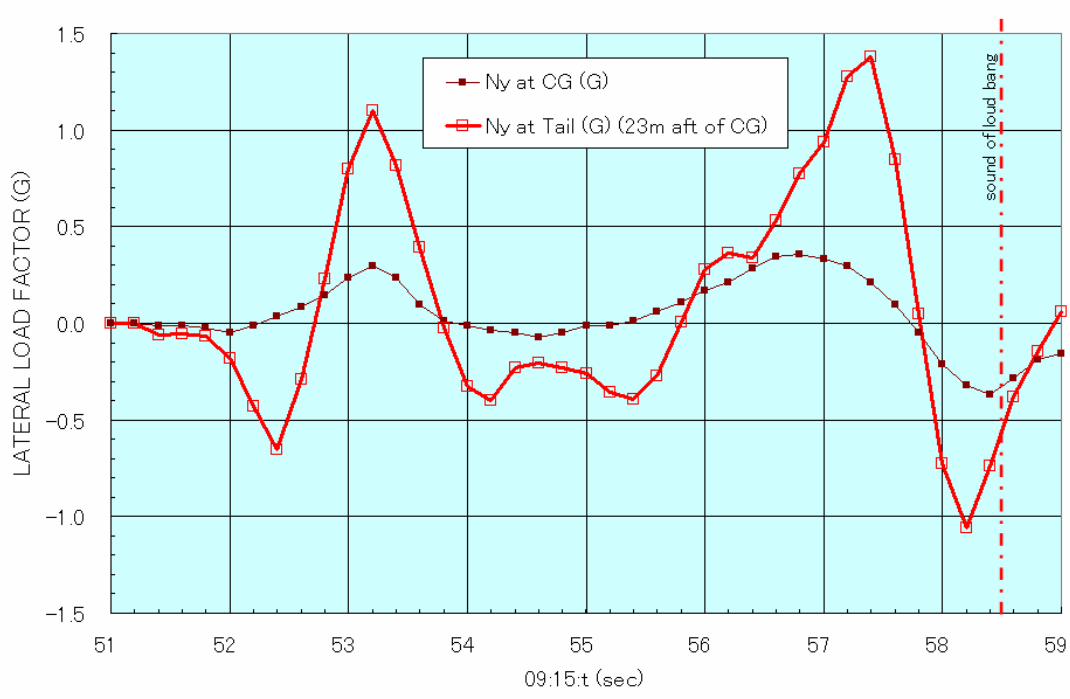

Fig. 2 Lateral Load Factor at Tail

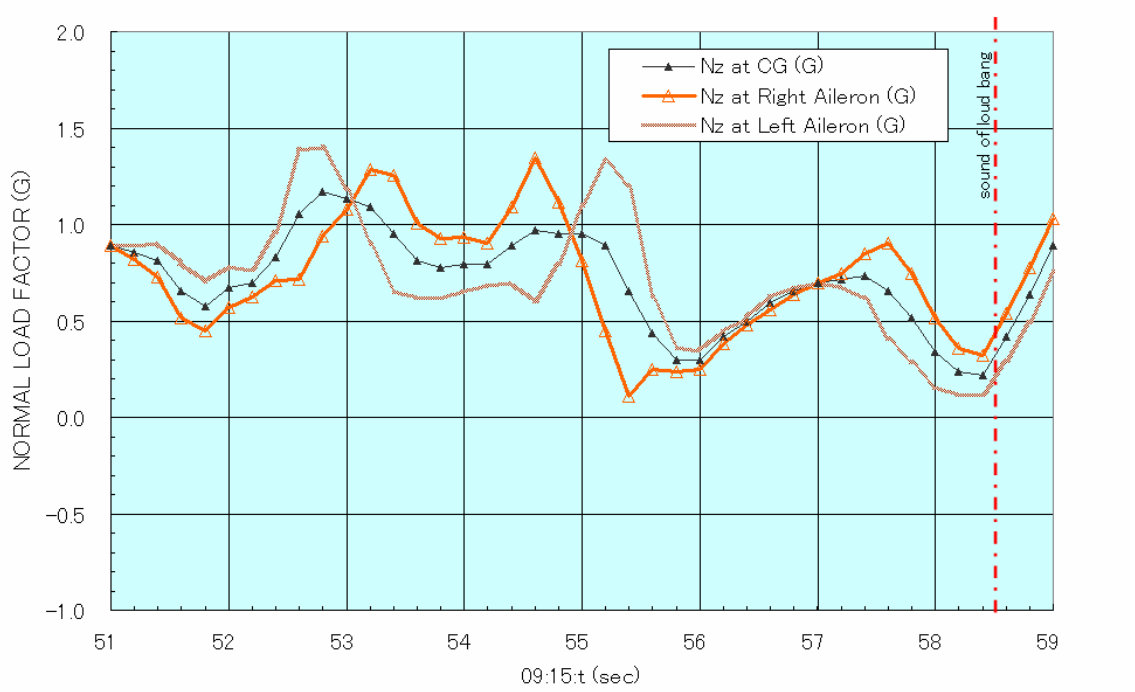

Fig. 3　Normal Load Factor at Aileron

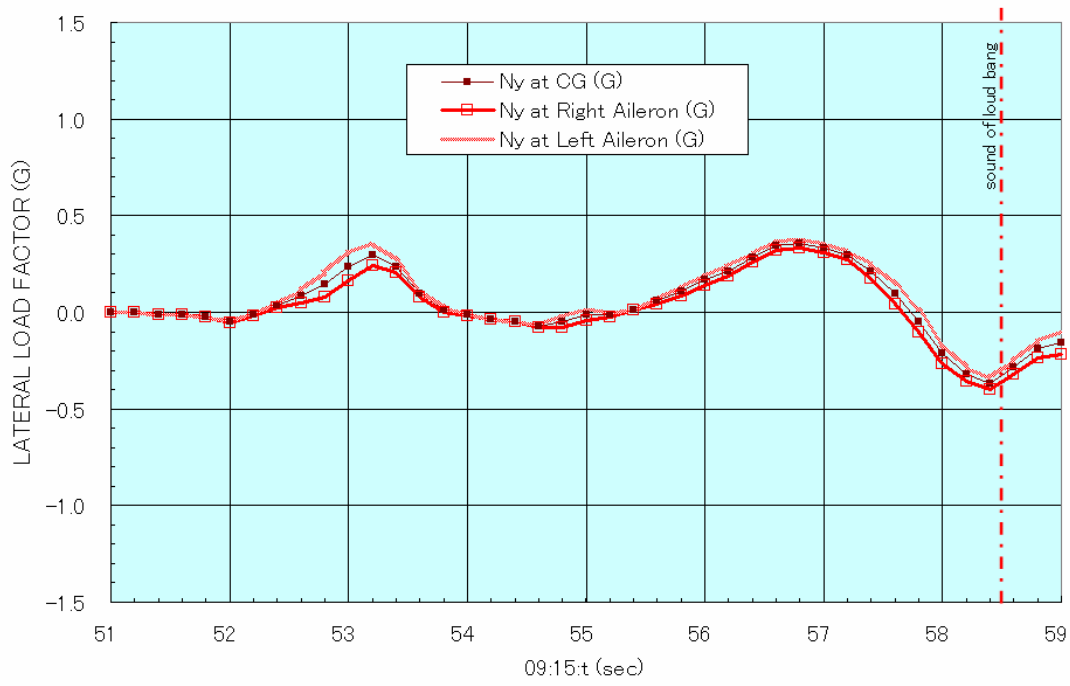

Fig. 4　Lateral Load Factor at Aileron

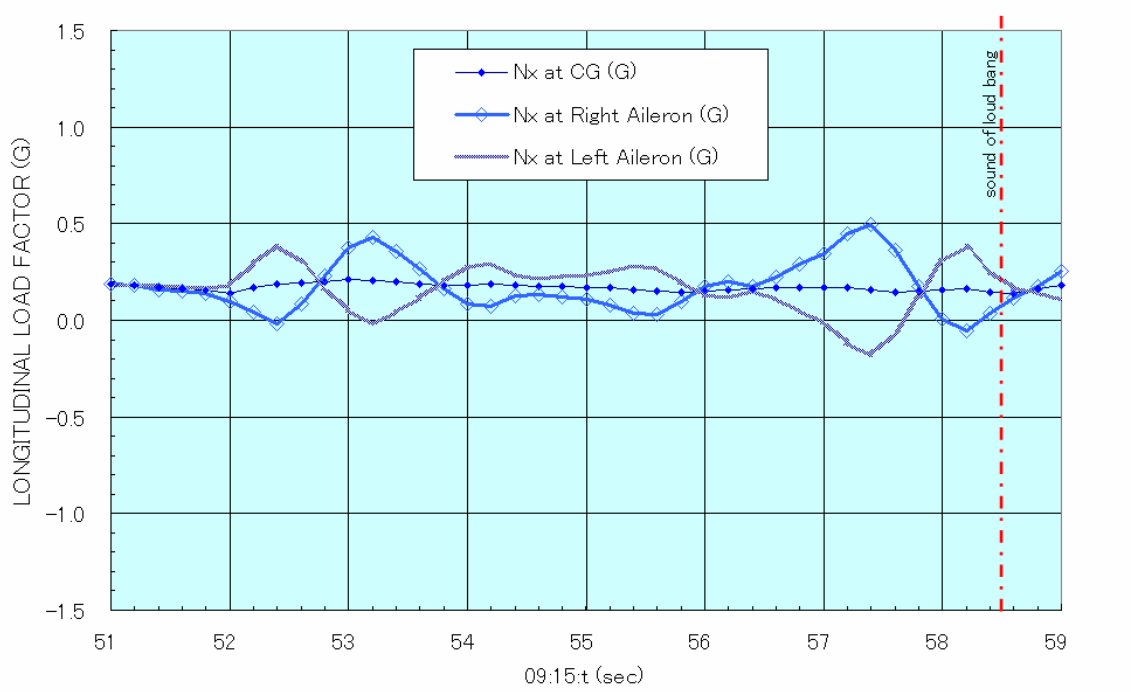

Fig. 5　Longitudinal Load Factor at Aileron

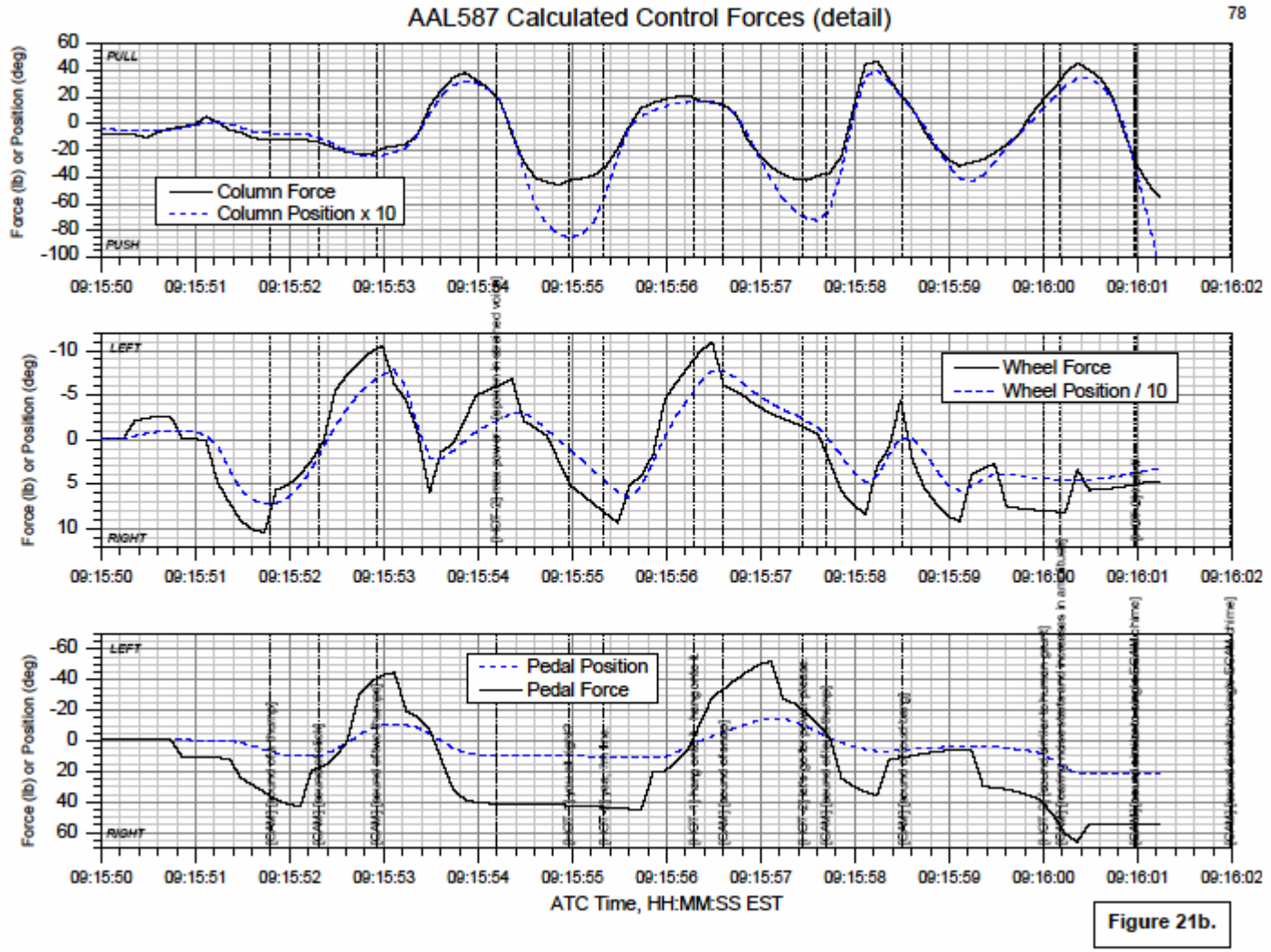

Fig.6 Control Positions and Calculated Forces (Ref. [1])

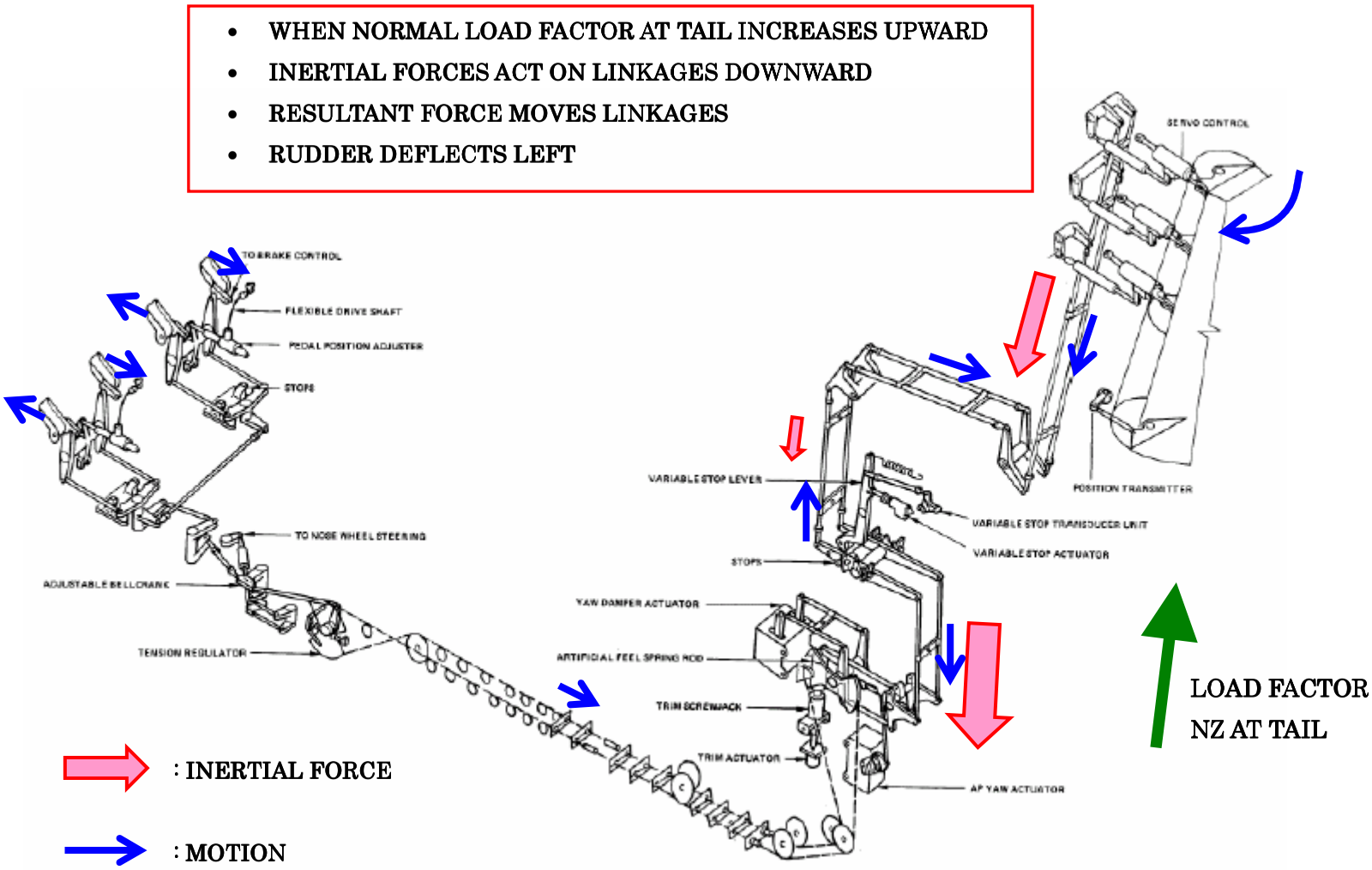

Fig.7 Rudder Control System (Ref. [2])

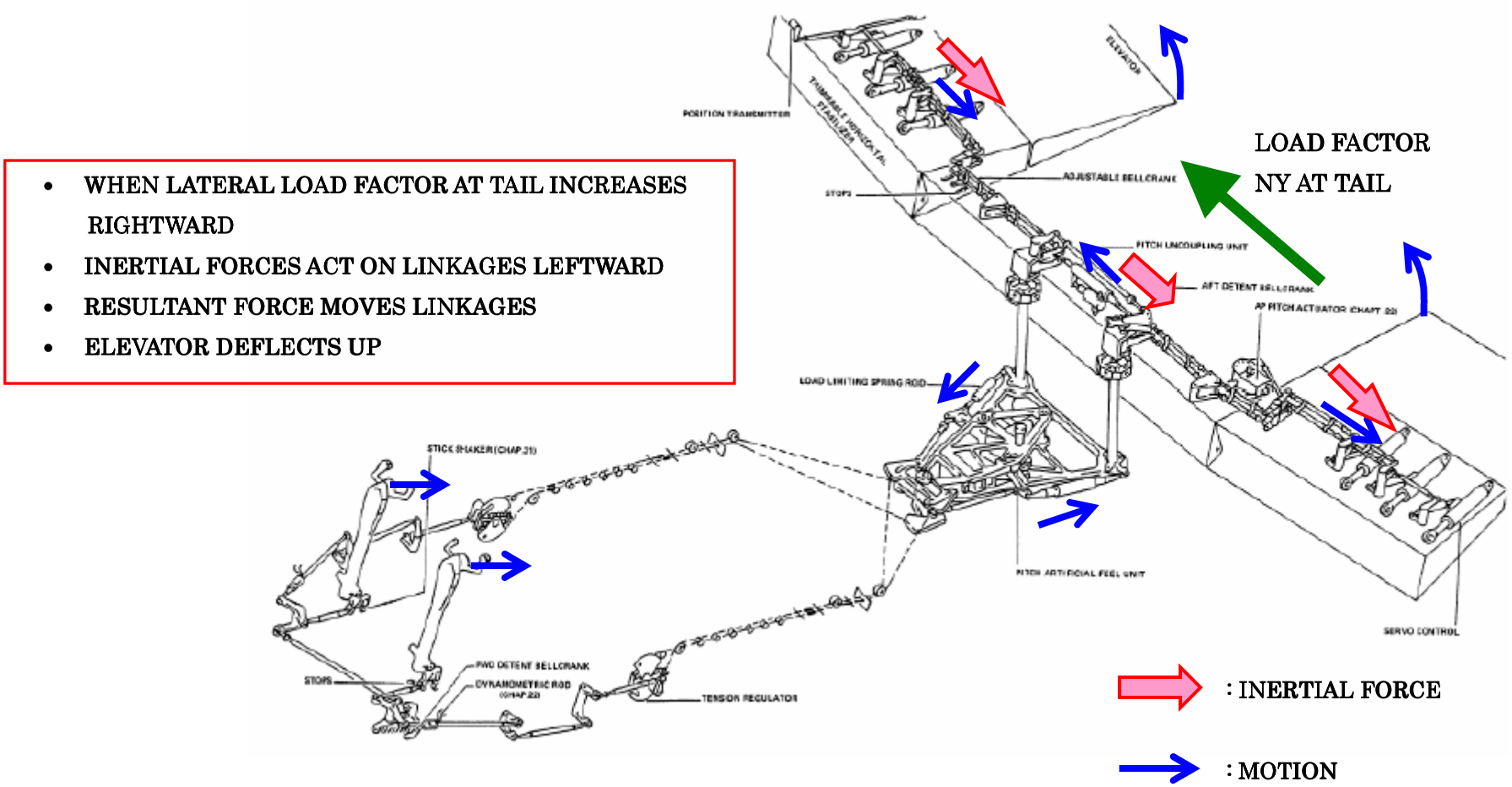

Fig.8 Elevator Control System (Ref. [2])

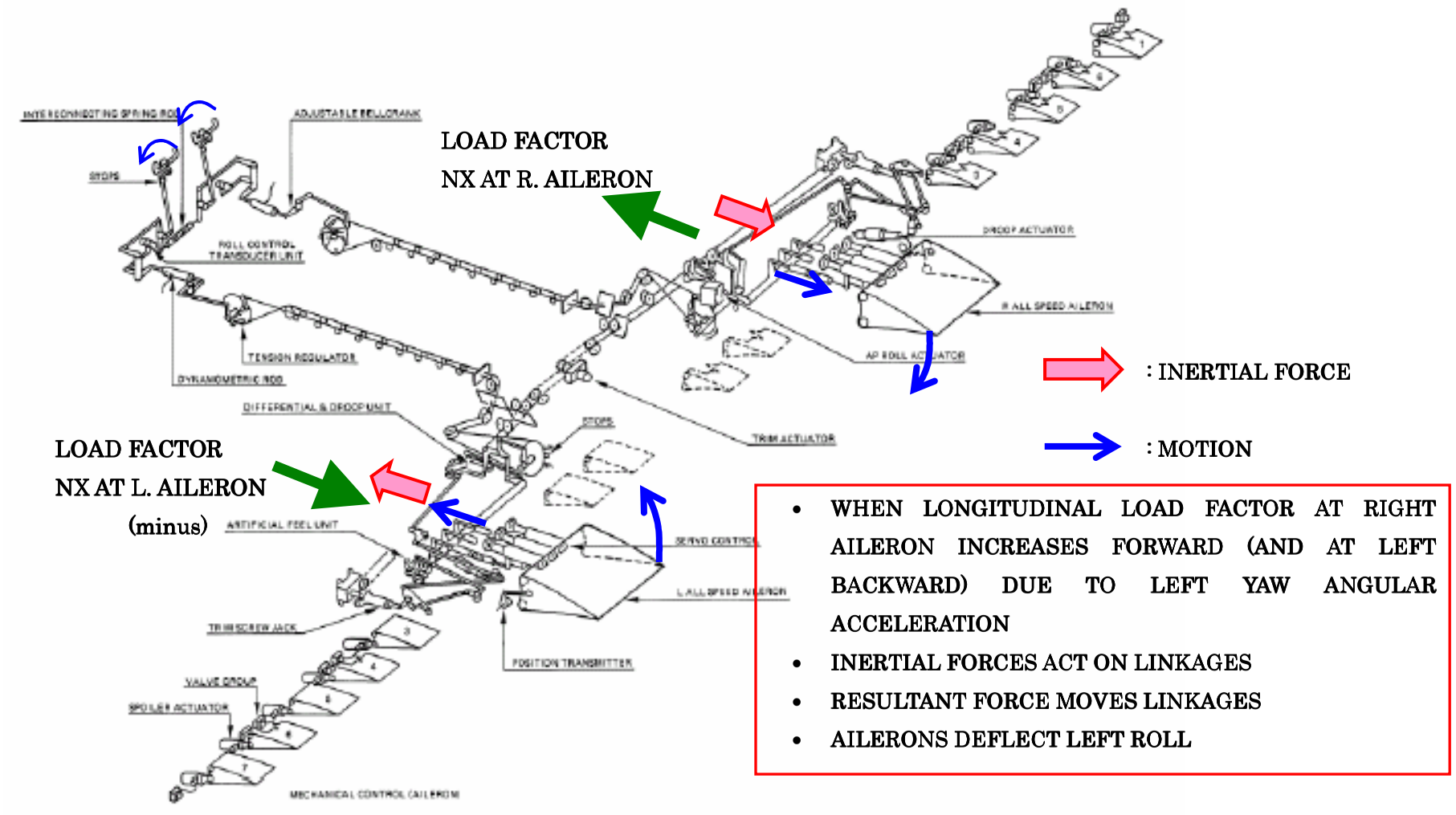

Fig.9 Roll Control System (Ref. [2])

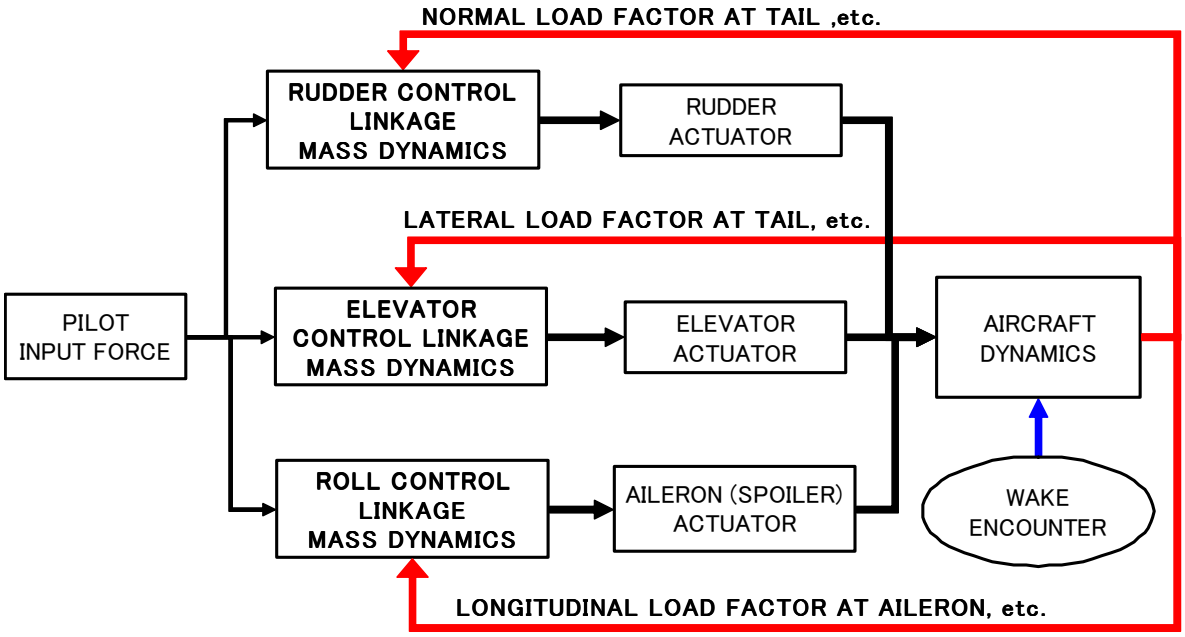

Fig.10 Block Diagram of Aircraft Dynamics with Linkage Mass Dynamics

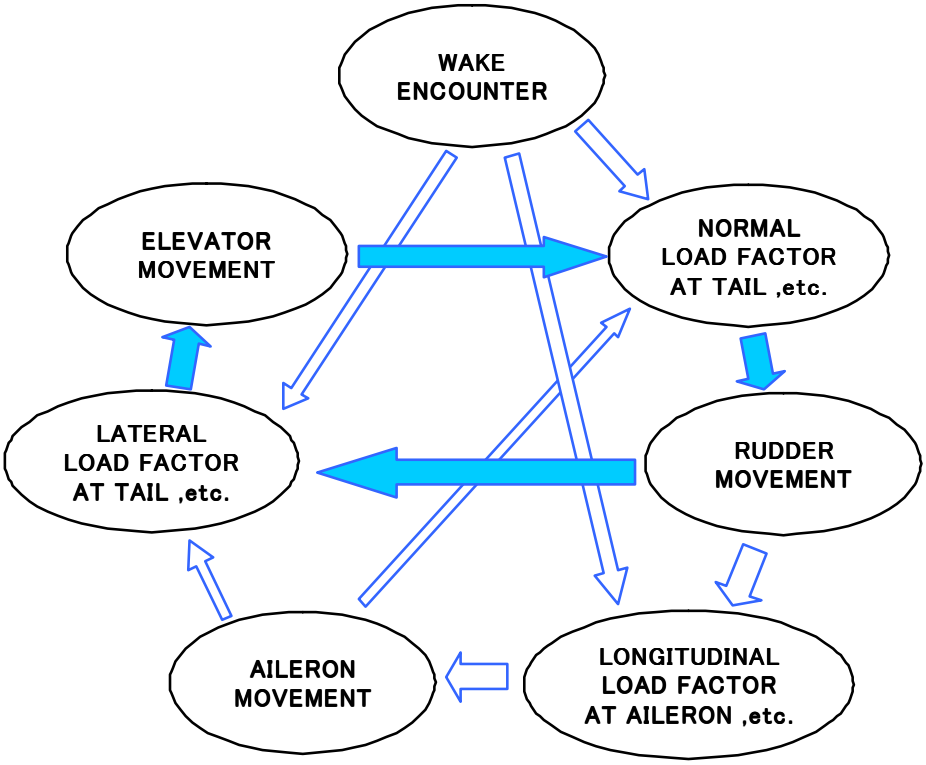

Fig.11 Chain of Event