Optimal Airplane Landing Gear Loads Analysis Based on Grey Relational Grade

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ABSTRACT

Airplane landing gear loads are hard to be obtained by utilizing theoretical method. Therefore, flight measurement is a good alternative in engineering. Before the flight measurement takes place, ground calibration test is required to obtain the relationship between the structural strain and load. This relationship will be used during flight measurement to transform strain data into load. Traditionally, we use regression analysis method to build this relationship with minimum error. In this paper, we present the grey relational grade to cardinal strain sensor test data. This cardinal can be used to select the representative parameters and construct a good "strain-load" equation, also, a *Matlab* toolbox is established to effectively generate this study.

Keywords: *Grey relational analysis, Analytic hierarchy process, Landing gear, Ground calibration test*

1. Introduction

The measurement of aircraft landing gear loads is required for a variety of purposes such as in research investigations and developmental testing. Although some methods permit the determination of aircraft structural loads, a more useful tool for the measurement of the overall loads on aircraft structures appears to be the wire resistance strain gage. In this study a basic calibration procedure is developed for calibrating strain-gage response with different applied forces on landing gear[1,2].

The Grey System Theory, first proposed by Professor Julong Deng in 1982[3], avoids the inherent defects of conventional, statistical methods and only requires a limited amount of data to estimate the behavior of an uncertain system. Means if the system exists not enough, not clear and not certain conditions, then we can say it is a grey system.

The field of the grey system can be summarized in six parts: Grey relational generating operation; Grey Relational Analysis, which includes localization grey relational grade and globalization grey relational grade; Grey Model; Grey Decision Making and Grey Control[4]. In summary, the main purpose of the grey system theory focuses on the relation between the analysis model construction, and for circumstances such as: no certainty, multi-data input, discrete data, and insufficient data through predicting and decision-making.

1.1 Strain Gage Installations and Test Arrangement

In Fig. 1, we show the landing-gear ground calibration test setup, and Figure 2 is the strain gage bridge installation diagram, which vertical and horizontal loads can be applied on the axle of the landing gear by the hydraulic system[1].

Sixteen different load condition(LC) are carried out and nine groups of data from the strain gage were obtained.

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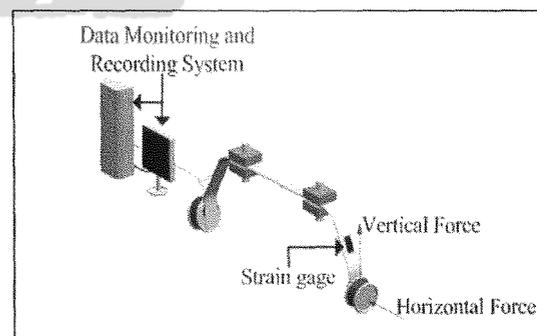Received: 25 May 2008
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Fig. 1 Landing-gear ground calibration test setup