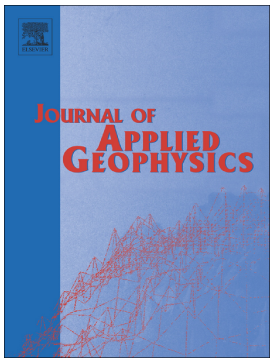


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# Airborne AFMAG method motion-induced noise simulation and suppression

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**Abstract**

This paper introduces a rotation matrix method to extract and suppress the motion-induced noise in airborne AFMAG method. The rotation matrix method is a straight-forward method which achieves the coordinate transformation based on Euler angles and predicts the motion-induced noise by calculating the angle between the sensor's normal and the geomagnetic field in real time. The corrected data can be obtained by subtracting the predicted noise from the movement electromagnetic data. We analyze the influence of the Euler angles and geomagnetic field (inclination and declination) on motion-induced noise. The comparison of the simulation result with existing method in literature is given and the consistency of the predicted noise by the two approaches confirm the effectiveness of the proposed method. A field data motion-induced noise correction is implemented and the result shows that the noise can be reduced by one or two orders of magnitude at low frequencies by rotation matrix method.

**Key words:**

Motion-induced noise; Euler angles; airborne AFMAG method; rotation matrix; simulation and suppression

## 1. Introduction

Airborne AFMAG method is a passive frequency electromagnetic (EM) method with frequency range from about 1 Hz to 10 kHz. The investigation depth of this method more than 1 km and have many applications since 1950s (Ward et al., 1959; Labson et al., 1985; Legault et al., 2009). However, the measured airborne EM response is strongly affected by motion-induced noise, power lines and VLF transmitters (Buselli and Hwang, 1998). Numerous of noise overlaying onto the target response result in the signal deviation. A variety of processing techniques are used to minimize the effects of noise, such as stacking, digital filtering, and referencing (McCracken et al., 1984; Macnae et al., 1984; McCracken et al., 1986). Compared with other noise sources, the motion-induced noise has notable characteristics both in airborne EM system and ground/ocean towed system (Boler and Miele, 2006; Lezaeta et al., 2005). The motion-induced noise is caused by the coil's tilt orientation changes ongoing in the earth magnetic field during data collection. The variations of the coil generates an inductive voltage which superimposes onto the subsurface response and leads to a severe distortion of the time series. The main energy of the motion-induced noise concentrates in low frequency band (Lane et al., 2000) and the amplitude may be orders of magnitude higher than the other noise sources (Munkholm, 1997).

A great effort has been done for distinguishing and suppressing the motion-induced noise both in hardware