

INFLUENCES OF INTERPLANETARY MAGNETIC FIELD ON THE VARIABILITY OF
THE AEROSPACE MEDIA

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VARIABILITY OF THE AEROSPACE MEDIA**

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ABSTRACT

INFLUENCES OF INTERPLANETARY MAGNETIC FIELD ON THE VARIABILITY OF THE AEROSPACE MEDIA

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The Interplanetary Magnetic Field (IMF) has a controlling effect on the Magnetosphere and Ionosphere. The objective in this work is to investigate the probable effects of IMF on Ionospheric and Geomagnetic response. To fulfill the objective the concept of an event has been created based on the polarity reversals and rate of change of the interplanetary magnetic field components, B_z and B_y . Superposed Epoch Method (SPE) was employed with the three event definitions, which are based on IMF B_z southward turnings ranging from 6 to 11 nT in order to quantify the effects of IMF B_y and B_z . For the first event only IMF B_z turnings were taken into account while for the remaining, positive and negative polarity for IMF B_y were added. Results showed that the increase in the magnitude of IMF B_z turnings increased the drop of F layer critical frequency, f_0F2 . The drop was almost linear with the increase in magnitude of polarity reversals. Reversals with a positive IMF B_y has resulted in the continuation of geomagnetic activity more than 4 days, that is to say, the energy, that has penetrated as a consequence of reversal with a positive B_y polarity, was stored in outer Magnetosphere, whereas, with a negative IMF B_y the energy was consumed in a small time scale.

At the second step of the work, although conclusions about geomagnetic activity could be done, as a consequence of data gaps for f_0F2 in addition to having low numbers of events,

characterization of f_0F_2 due to constant IMF B_y polarity could not be accomplished. Thus, a modeling attempt for the characterization of the response due to polarity reversals of IMF components with the Genetic Programming was carried out. Four models were constructed for different polarity reversal cases and they were used as the components of one general unique model. The model is designed in such a way that given 3 consecutive value of f_0F_2 , IMF B_y and IMF B_z , the model can forecast one hour ahead value of f_0F_2 . The overall model, GETY-IYON was successful at a normalized error of 7.3%.

Keywords: Magnetosphere, Ionosphere, Interplanetary Magnetic Field, Modeling, Genetic Programming

ÖZ

GEZEĞENLERARASI MANYETİK ALANININ HAVACILIK VE UZAY ORTAMINDAKİ OLASI ETKİLERİ

Yapıcı, Tolga

Yüksek Lisans, Havacılık ve Uzay Mühendisliği Bölümü

Tez Yöneticisi : Prof. Dr. Yurdanur Tulunay

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Gezegenerarası Manyetik Alanın (IMF), Manyetosfer ve İyonküre üzerinde kontrol edici etkisi vardır. Bu çalışmada amaç Gezegenerarası Manyetik Alanın İyon küresel ve Jeomanyetik olası etkileri incelenmektedir. IMF'nin z yönündeki bileşeni, IMF B_z 'nin 6 nT ile 11 nT arasında değişen büyüklüklerinde, 3 adet "olay" tanımına dayalı "Superposed Epoch" yöntemi uygulanmıştır. Birinci "olay" tanımı için sadece IMF B_z kutuplaşma dönüşleri değerlendirilirken, diğerleri için pozitif ve negatif IMF B_y kutuplaşması eklenmiştir. Sonuçlar, IMF B_z kutuplaşma dönüşlerindeki büyüklüğün artışının, F katmanı kritik frekansı, f_0F_2 'daki düşüşü artırdığı göstermiştir. Düşüş, neredeyse, kutuplaşma dönüşünün büyüklüğü ile doğrusal olarak değişmektedir. Pozitif IMF B_y ve IMF B_z kutuplaşma dönüşleri sırasında, Jeomanyetik aktivitenin 4 günden fazla devam ettiği sonucuna varılmıştır.

Çalışmanın ikinci basamağında, Jeomanyetik aktivite hakkında bazı sonuçlara varılabilmişse de, düşük sayıdaki olaylara ek olarak f_0F_2 verilerindeki boşluklardan ötürü, f_0F_2 'ye sabit IMF B_y kutuplaşmasının etkisinin tanımlanması yapılamamıştır. Bu yüzden, IMF kutuplaşma dönüşlerinin etkilerinin tanımlanması için "Genetik Programlama"yla modelleme denemesi yapılmıştır. Değişik kutuplaşma dönüşleri için dört model oluşturulmuş ve bu modeller tek genel ve eşsiz bir modelin bileşenleri olarak kullanılmıştır. Model verilen ardışık 3 saat-

lik f_0F2 , IMF B_y ve IMF B_z verileriyle bir saat sonraki f_0F2 deęerini kestirmek iin dizayn edilmiřtir.

Anahtar Kelimeler: Manyetik Kre, İyonkre, Gezenler Arası Manyetik Alan, Modelleme, Genetik Programlama

To my family and my lovely girl friend

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