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ポスター１：11/4　PM1/PM2 （13:45-18:15）

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Effects of increasing the frequency resolution of FFT on the density estimation from the SuperDARN data

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There are several kinds of waves driven by the solar wind, including those associated with sudden impulses (SI). The upstream impulses and/or waves can propagate into the magnetosphere, and can excite eigen-oscillations of the field line with frozen-in plasma, that is, field-line resonance (FLR), where the wave frequency matches the eigen-frequency of a geomagnetic field line. It is known that the gradient methods (collective name for the amplitude-ratio method and the cross-phase method) enable us to effectively extract FLR signals from observed data including non-FLR signals as well. From thus identified FLR frequency one can estimate the mass density of plasma along the magnetic field line, because, in a simplified expression, 'heavier' field line oscillates more slowly.

We have been applying the gradient methods to the VLOS (Velocity along the Line of Sight) data of the SuperDARN radars. The radars emit azimuthally-collimated beams of radio waves in the HF range, and some of them are backscattered by the ionosphere (mainly through 1/2-hop paths), while some others are backscattered by the ground and the sea (mainly through one-hop paths). From the Doppler shift of backscattered signals, one can calculate VLOS. Ionosphere-backscattered signals yield VLOS of the horizontally-moving ionospheric plasma (at mid- to low latitudes, VLOS also has vertical component, because the ambient magnetic field is tilted), while ground/sea-backscattered signals yield VLOS corresponding to the vertical motion of the ionospheric plasma, because the length of the ray path of a beam can only be changed by the vertical motion of the ionosphere.

For a 30-min-interval event after an SI, we applied the gradient methods to VLOS data obtained from different beams and range gates, and successfully identified the FLR in both the ionosphere-backscattered signals and sea-backscattered signals. The mass density was thereby estimated using both scatters. As a result, the latter was significantly smaller than the former.

We infer that this large difference could come from a fairly large frequency spacing of the FFT analysis due to the fairly small duration (30min) of the event. Thus, in this paper we have increased the frequency resolution by zero-padding; it is worth noting here that the gradient methods use timeseries data obtained at two locations and takes the ratio of the FFT results of the two data, and thus that the decrease in the amplitude due to zero-padding is cancelled out.

As a first test, we zero-padded certain periods just after the observed period so that the time length was elongated to 90 min. As a result, the frequency resolution became three times higher, and thus the FLR frequency became more precise. From these higher-precision FLR frequencies we estimated plasma densities, and the above-stated density difference between the ionosphere-backscattered signals and the sea-backscattered signals became smaller. In this presentation we report the results of further testing and examination of the zero-padding, bearing in mind that it will be meaningful to compare the result of zero-padding with the result of applying the Lomb-Scargle method to the original data.