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Quality assessment of sub-Nyquist recovery from future gravity satellite missions

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When using high quality sensors in future gravity missions, aliasing of the high frequency geophysical signals to the lower frequency signals is one of the most challenging obstacles. Two sampling theorems mainly govern the space-time sampling of a satellite-mission: (i) the "Nyquist-theorem" $\beta \geq 2L$ (or $2M$) which limits the spatial resolution (maximum degree/order L/M), where β is the number of satellite revolutions per α nodal days, and (ii) the "Heisenberg-theorem" $D_{space} \times D_{time} = 2\pi\alpha/\beta = 2\pi T_{revolution} = const.$ means that the product of spatial resolution D_{space} and the time-resolution D_{time} is constant. These two facts necessitate to employ more than one satellite mission to improve the temporal and spatial resolutions simultaneously. Moreover, several studies have shown that measuring other observable than the along track GRACE measurement improves the quality of the solutions. Different configurations, Pendulum, Cartwheel, LISA, Helix have been suggested for the improvement, although there are some technical concerns with their implementations.

It is obvious that short-time solutions of the configurations are less affected by the temporal aliasing, while they are suffering more from spatial aliasing. The purpose of this presentation is to investigate the quality of sub-Nyquist solutions of different formation flights in particular the dependence of such quality on the measurement duration and orbital coverage. We suggest optimal configurations in both time and spatial domains, by the help of post processing tools like EOF + KS test analysis and regularization. The full repeat period solutions of these formations are studied versus their shorter time solutions by a quick look simulation software. The sub-cycle concept is also discussed and investigated.