IVS Memorandum 2006-021v01

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"Preliminary Scheduling in 2010 Paradigm"

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To: VLBI2010 Committee
From: Anthony Searle
Subject: Preliminary scheduling in 2010 paradigm

In his paper, "Achieving a Quantum Leap in Observation Density" Bill Petrachenko suggested it is possible to have each station in the 2010 network taking an observation every 30 seconds. To that end we have developed a simple algorithm that schedules dense observing at that rate. Some schedules are examined to look at the UV coverage to look at the potential for source mapping from the 2010 observations. Some of the consequences of this new paradigm are discussed.

Algorithm

The goal of achieving 2880 observations per day per station led to a simple approach. For each source selected for the session, a pair is found that is closest to antipodal. Each source is then chosen randomly from the source list as the primary source. Stations that can see the primary source are scheduled to observe it; the antipodal source is scheduled for the remaining stations. A scan with a duration of 5 seconds is scheduled every 30 seconds. Occasionally, the source will appear below the horizon cut-off for a station, and no source will be available as a result, on average, the stations observe ~100 scans per hour.

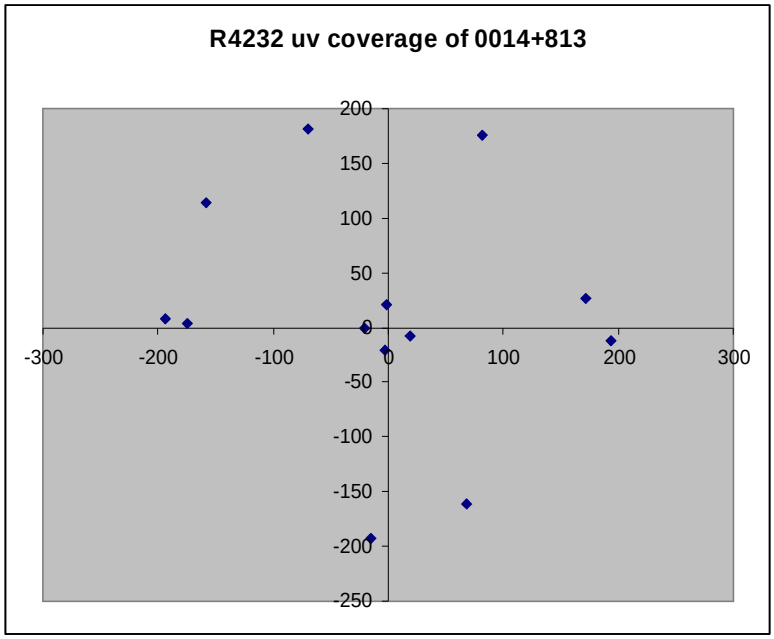
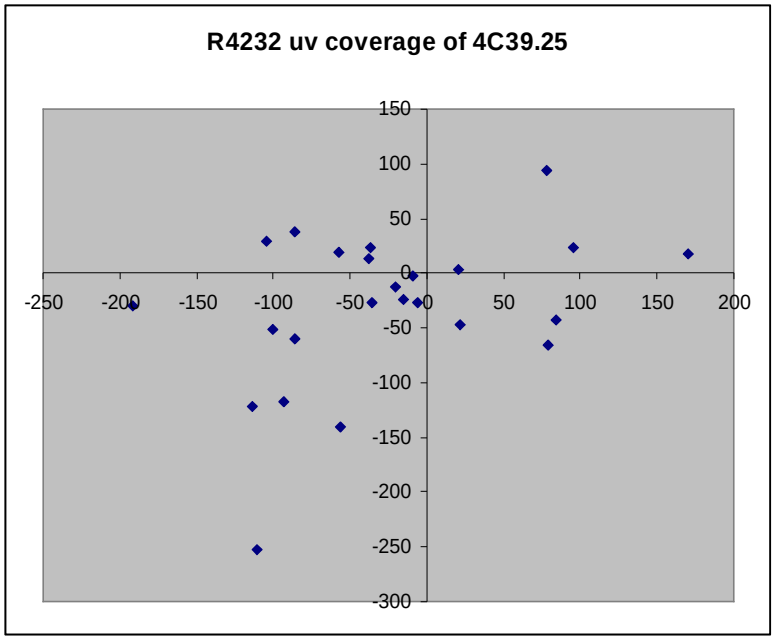
Shortcomings:

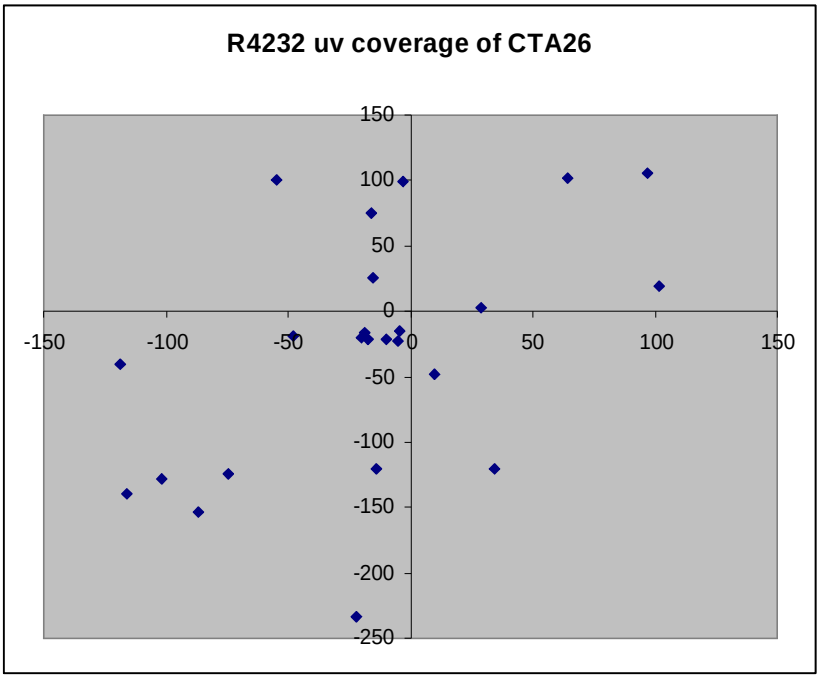
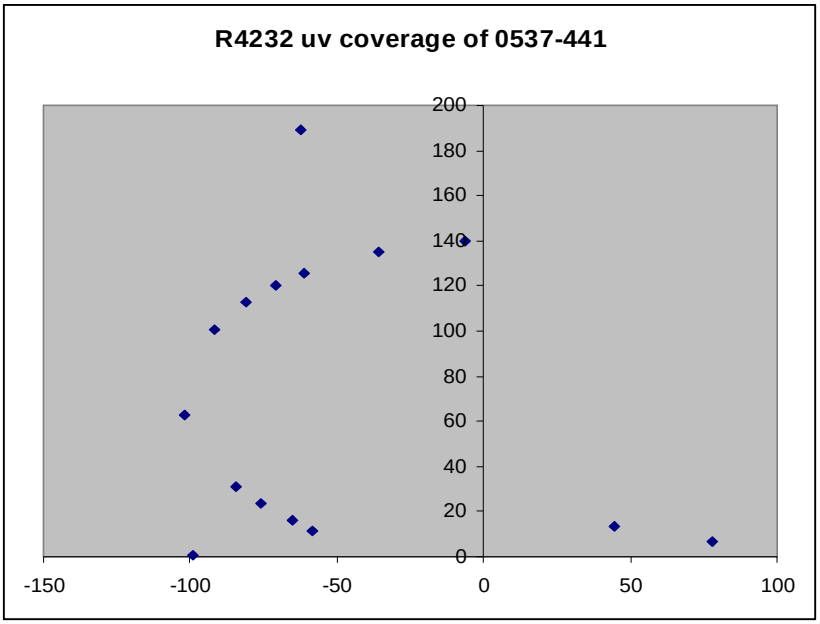
- In some cases a source will be the antipodal pair to several sources; conversely some sources are not paired as a secondary. The source sampling is uneven as a result.
- No effort has been made to find an alternate source for stations that cannot either of the two sources
- Only 100 sources were used in these schedules

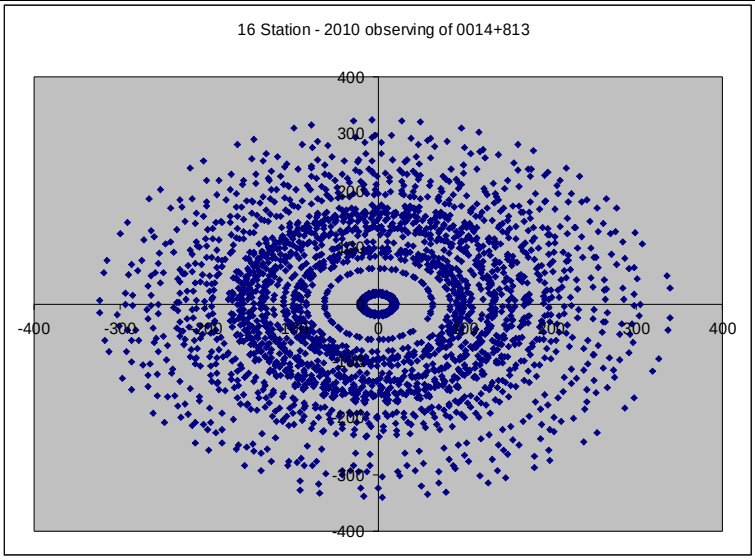
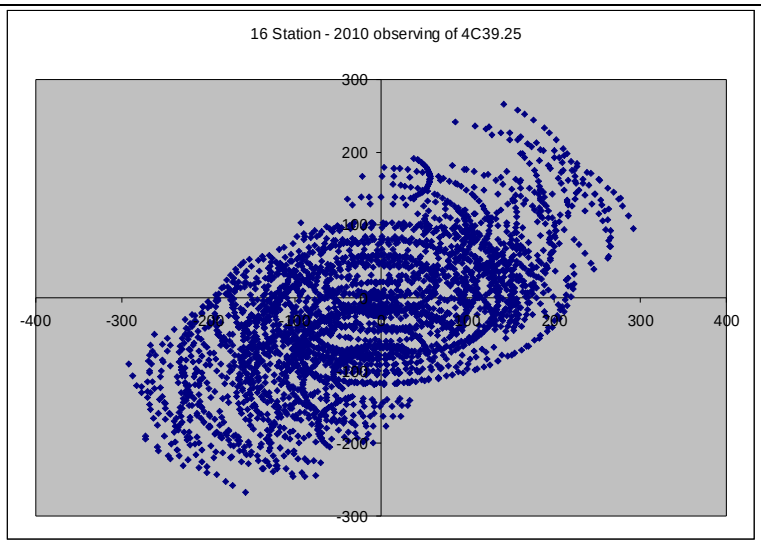
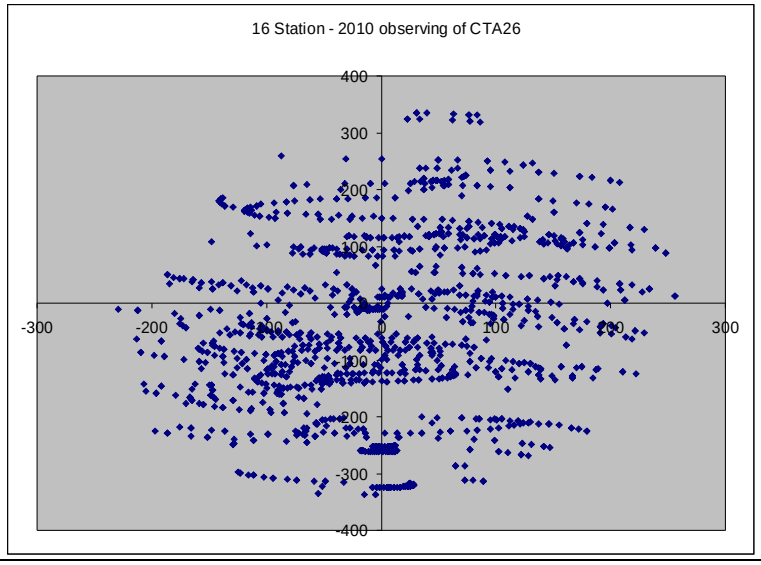
UV Coverage

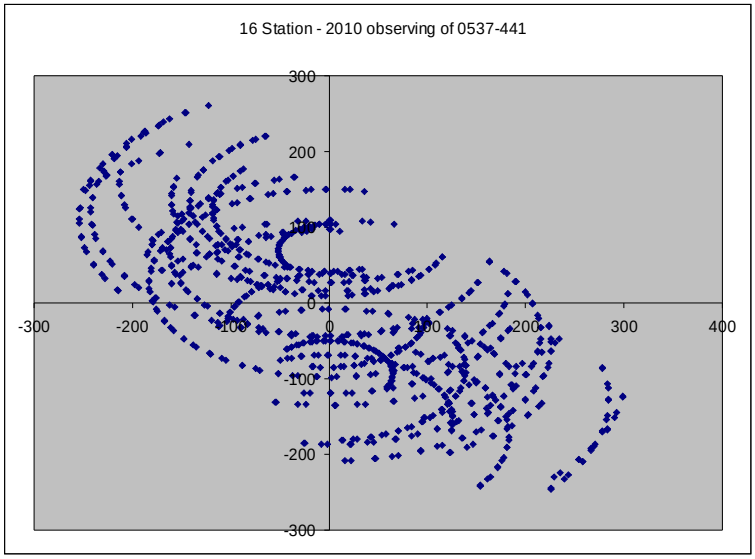
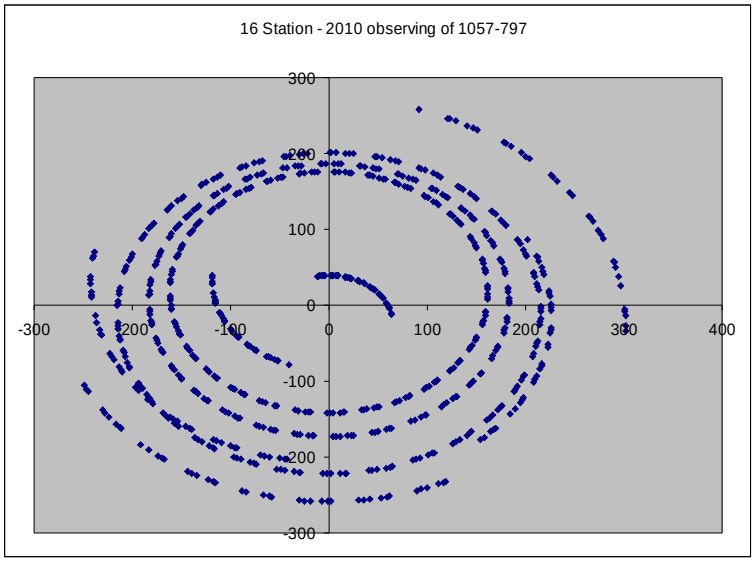
The significant increase in observations greatly increases the UV coverage for a source in a day. At present the UV sampling is only tens of points per session, with newer scheduling, thousands of points are taken. Below, the UV coverage for three schedules for the following sources are plotted 0014+813 (+81.5°), 4C39.25 (+39.1°), CTA26 (-2.0°), 0537-441 (-44.1°), and 1057-797 (-80.1°).

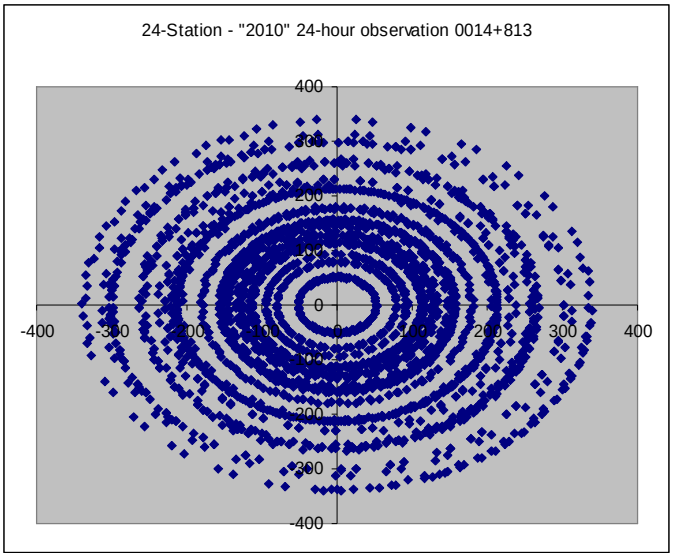
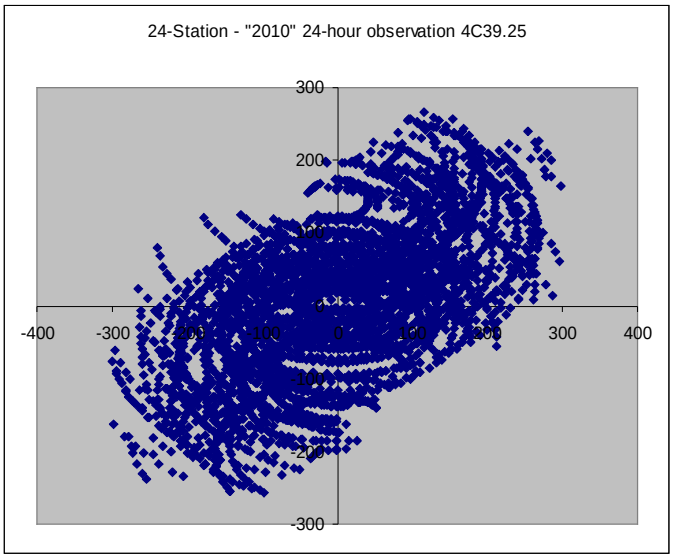
The first schedule is the existing schedule for R4232 that uses current scheduling practices. The second schedule uses a 16-station network using a "realistic" station distribution, which uses the sites for 8 current stations and 8 fictitious stations. The resulting network has 8 "northern" stations with latitudes greater than +20°, 5 "equatorial" stations between +20° and -20°, and 3 "southern" stations below -20°. The third schedule uses a fictitious network of 24 stations that are distributed evenly between hemispheres. The units of the plots below are millions of 8.5 GHz wavelengths.

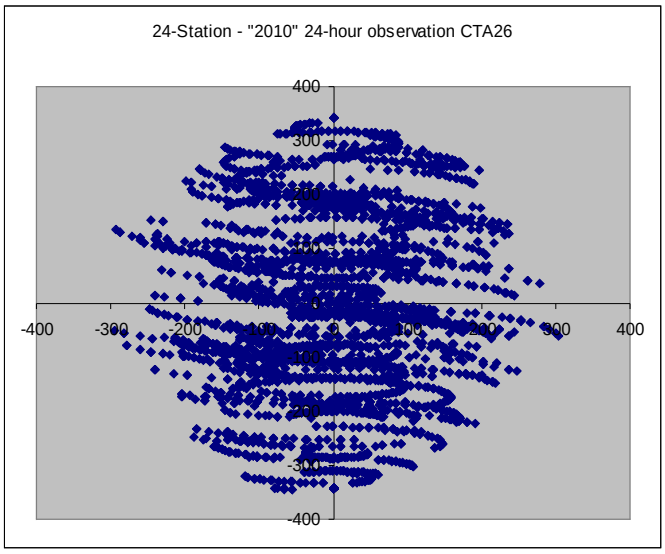
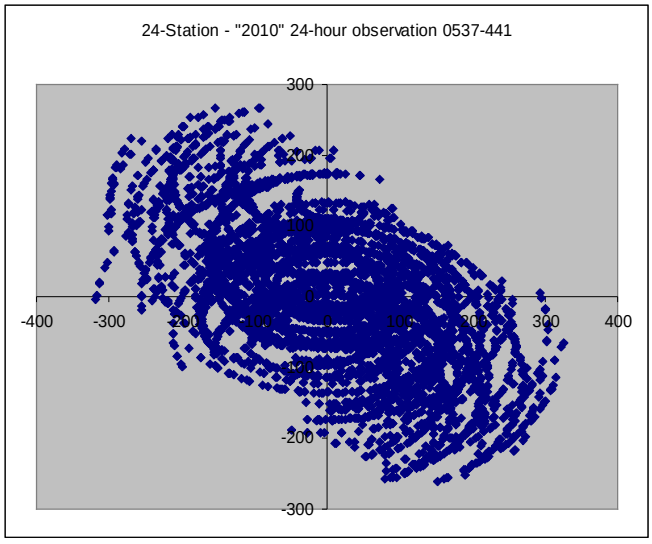
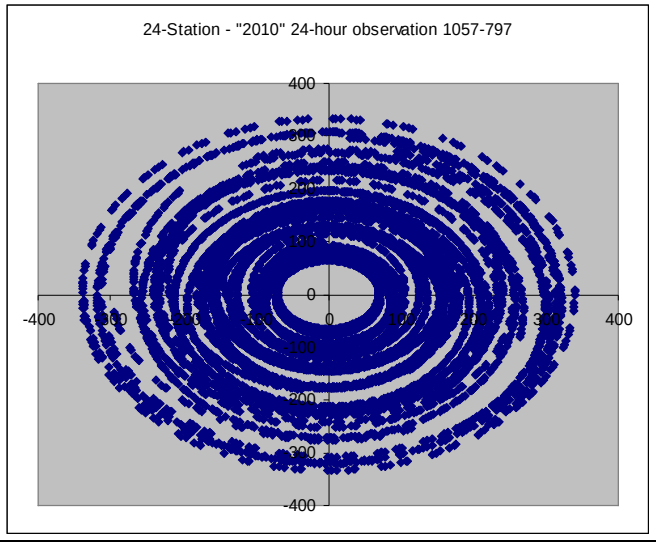
Source	R4232
0014+813	
4C39.25	

CTA26	
0537-441	
1057-797	Does not observe below -44 degrees

Source	16 Station “2010” Network
0014+813	
4C39.25	
CTA26	

0537-441	
1057-797	

Source	24 Station “2010” Network
0014+813	
4C39.25	

CTA26	
0537-441	
1057-797	

Comments

Even though each station is observing many more time per day they spend much of their time idle because the slew rates are much faster than required for the average slew. If a certain number of stations are allowed to "miss" a given scan then it would be possible to either use slower stations for scans every 30 seconds or increase the observations per day even further.

As the number of stations increases, the number of delays per day increases rapidly, the 24 station scan has over 300000 delay measurements, roughly equivalent to the annual output of the R1/R4 sessions of today. As we move toward 2010, the computational load will increase exponentially.

Simple scheduling algorithms may offer a way to use existing antennas in 2010, if the pseudo-random source list is known at all stations (or can be calculated), then a station should be able to calculate which sources it will be able to observe in the session and contribute where it can.