Outline of potential combined solutions：
an view from KARST project team in China

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1. Combined with AAT

In order to enlarge the FoV and the sky coverage of the FAST, we have set-up a project to investigate our own focus array at the FAST focus, adopting the AAT technology. This combined solution for large dish will enlarge the FoV of the 300m illuminated area of the FAST from ~3 arcmin to half a degree and form at least 100 simultaneous beams within it. The phased array technology also enables us to form an asymmetric illumination pattern as the focus goes to the edge of the active reflector by dynamically weighting the Vivaldi-elements in the array. This kind of focus can get avoid the pick-up from ground without involving the complex and expensive metal fence around the main dish as Arecibo telescope. The application might be also possible to reduce the surface accuracy request by correcting the errors of large dimensional scales on the reflector at the focus.

There are three groups working on the layout design of the AAT type feed from Tsinghua University, Beijing Astronautics University and NAOC. The array will include 1300 vivaldi antennas on a plate of diameter 2.5 m by a very rough estimation. The electromagnetic field analysis near focus has been completed now, and the results appear close to the ones of FARADAY project.

2. Combined with LAR

LAR and FAST face to number of similar technical challenges. Both have flexible network to support the focus package – aerostat or suspended cables. The analysis on the dynamic characteristics of the soft system could be compared and checked by each other through cooperation. Some feasibility studies on practical engineering realization are possibly applicable to each other, and approved by some experiments, i.e., stabilizer of feed pointing/tracking.

Their active reflectors also share many key techniques as segmentation of the surface, mechanical control of the active elements, low-cost panels and their reliability, complicated fieldbus to drive large amount of actuators, and maintenance etc.

LAR and FAST require powerful ranging system to measure the spatial position of feed or feed platform (3-D solid body). The ranging system need to work at large distance of km with high refresh rate to track those moving and oscillating objects, and at high accuracy of about sub-mm scale. The equipment operates in open air and must be well calibrated.

There are no solid connections between the focus and reflector as those conventional antennas. Pointing and tracking, as well as the harmonization between feed and reflector, are difficult to FAST and LAR.

3. Combined with Preloaded

The previous design of the FAST reflector consists of ~2000 hexagon-shaped elements, whose back structure is made of large amount of steel rods and spherical joints. Recent years, element of tensegrity back structure of FAST has been modeled and evaluated by the expert board as a feasible solution to future FAST reflector, reducing its total weight by a factor 3. This design replaces solid network by preloaded steel wires without welding technics, which is applied by Indian concept. From the experiment, we learnt how to distribute and measure the tension forces in the prestressed structures, and how to control the energy-loss. The merit of this technology is its potential advantage in reducing the project cost of all kind of SKA concept. FAST elements have identical curvature and little dimension difference, Indian preloading process seem to be helpful for the mass production of FAST elements.

4. Site

Compared with those site surveying programs, Karst site shows two outstanding aspects – large number of candidate depressions of perfect anti-cone profiles and the extremely quiet RFI environment due to remoteness and the local terrestrial shielding. We believe that Karst site benefits AAT- type SKA concept which is not expected to operate at very high frequencies and is limited to large zenith angles.

5. Commons

Besides combines solutions mentioned above, there are certainly many R&D developments in different concepts are in common, e.g. science drivers, array optimization, day-1 receivers and back terminals of different purposes, data transmission and correlation, and post data analysis.