

## Tips for matching Yagi-Uda Antennas

- 1) Pick reasonable values for the match (see below).
  - Diameter of feed  $2a'$ - usually you will want this to be less than the Yagi-Uda element diameters  $2a$  to make  $\alpha > 1$ .
  - Feed spacing  $s$ - make less than  $s_{12}/4$ , more than 1 cm (practical construction), and less than 5 cm (don't want the characteristic impedance of the feed section  $Z_{0t}$  to be too large).
  - Feed length  $l'$  or  $l'/2$ - make less than a quarter of the initial driven element length  $l_2/4$  to avoid overly disturbing the current distribution .
- 2) Run NEC-2 on your initial try w/ driven element broken into three pieces (driven element tips w/ radius  $a$  and middle/Gamma-match portion w/ radius  $a_e$ ) to get  $Z_A$ . Then, calculate the overall input impedance  $Z_{in}$ .
- 3) Next try(s), adjust driven element length  $l_2$  to get antenna back to resonance. I.e., If  $Z_{in}$  has negative reactance, make  $l_2$  longer. If  $Z_{in}$  has positive reactance, make  $l_2$  shorter. When adjusting element lengths, maintain symmetry! I.e., if shortening an element by 2 mm, take 1 mm off each tip. Make smallish adjustments (no more than a couple millimeters at a time)!
- 4) Once you get to or close to resonance (e.g.,  $X_{in} < 1 \Omega$ ), is  $Z_{in} \approx R_{in}$  too small or too big?
  - a) If fairly close to spec, you can try adjusting  $l'$  or  $l'/2$  and  $s$  (usually don't bother w/  $2a'$ ) to increase/decrease the current divisor factor  $\alpha$  and hence the size of  $R_{in}$ . Will usually need to tweak driven element length  $l_2$  again to get back to resonance.
  - b) From experience, increasing length of the reflector  $l_1$  usually helps increase  $R_{in}$ . Make smallish adjustments (no more than a couple millimeters at a time)! Will usually need to tweak  $l_2$  again to get back to resonance. Keep an eye on the gain and FB ratio.
  - c) From experience, decreasing length of the first director  $l_3$  helps usually helps increase  $R_{in}$ . Make smallish adjustments (no more than a couple millimeters at a time)! Will usually need to tweak  $l_2$  length again to get back to resonance. Keep an eye on the gain and FB ratio.

### Overall

- Unless you have lots of experience (only me at SDSMT), only change one variable at a time.
- Big changes lead to ping-ponging past the sweet spot.
- When adjusting element lengths, maintain symmetry! I.e., if shortening an element by 2 mm, take 1 mm off of each tip.
- It is best to semi-automate process by using MathCad, Matlab, ...