Tips for matching Yagi-Uda Antennas

1) Pick reasonable values for the match (see below).
   - Start with driven element l_2 either simple average or geometric average of l_1 & l_3.
   - Diameter of feed $2a'$- 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 4 cm (don't want the characteristic impedance of the feed section Z_{0t} to be too large, $200 < Z_{0t} < 300\ \Omega$ works well).
   - Feed length l'- make less than a third of the initial driven element length to avoid overly disturbing the current distribution $l' \sim l_2/4$ works pretty well. Divide by 2 for Γ-match length $l'/2$.
2) Run NEC-2 on your initial try w/ driven element broken into three pieces (driven element tips w/ radius a and middle/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 to resonance. I.e., If Z_{in} has negative reactance, make l_2 longer. If Z_{in} has positive reactance, make l_2 shorter. Make smallish adjustments (no more than a couple millimeters at a time)!
4) Once you get to or close to resonance (e.g., $X_{in} < 2\ \Omega$), is $Z_{in} \approx R_{in}$ too small or too big?
   a) 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.
   b) 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.
   c) If fairly close to spec, you can try adjusting match length (l' or $l'/2$) or s (usually don't bother w/ $2a'$) to increase/decrease the current divisor factor α and hence the size of R_{in}. Will usually need to tweak driven element length l_2 again to get back to resonance.

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, ...