Comments on thesis "Spectrum Sensing in Cognitive Radio Using Distributed Sequential Detection"

The thesis presents new spectrum sensing algorithms based on decentralized sequential hypothesis testing. The thesis presents a solid body of work in the area, and the student should be proud of his effort. This is clearly amongst the best master's thesis I have seen in recent years. It is also well written.

A few comments:

1. It appears that some figures are made with color. Do take care that the figures look good in black and white.
2. A table of abbreviations will be very useful. In many places, variables are defined within text, making the material a bit difficult to read.
3. Your scheme implicitly censors the decisions at the cognitive radios. Is any work on censored spectrum sensing relevant here? Even otherwise, it will be useful to refer to some of these works.
4. Some assumptions commonly made in cognitive radio are a bit far-fetched. This comment is not specific to your work. In your thesis, you always assume that the decision variable at the receiver is *real*. Implicit in this is the assumption of perfect carrier phase offset synchronization! At these low SNRs, how realistic is this assumption? Even the assumption of carrier frequency offset synchronization appears to be far-fetched. After all, you do not have the advantage of any sort of training, and you are not even aware of the presence or absence of the primary. Energy detection clearly tolerates these errors well, and your algorithms based on energy detector (analysis presented in section 3.5+) will perform well.
5. Another assumption commonly made in cognitive radio that I find troublesome is this. You assume (like almost everyone does) that you have perfect symbol timing. When x(t)=\sum_{n} a_{n}p(t-\epsilon-nT) is sampled after matched filtering by the pulse p(t) (assumed to be known), then the samples x(kT) will be correlated to each other unless \epsilon is zero. For this reason, the likelihood functions (and expressions like 3.3) are more difficult to write. Since you have assumed that the samples are independent, you effectively assume a) that you know p(t), and b) that the timing synchronization is perfect. The second assumption is troubling. How can you have perfect timing synchronization? You do not have benefit of training, and you are working at very poor SNRs. Performance of energy detectors also varies with timing error, and this depends on the roll-off factor of the raised coding pulse (the excess bandwidth). However, for reasonable excess bandwidth, you have small variations in the energy, and energy detectors still perform well. When the excess bandwidth is small, performance does degrade. Note also that this timing delay is different at different CRs. This issue in no way undermines the work presented in this thesis though. While likelihood functions will possibly be different, the energy detectors will work fine (but with some degradation) Taking correlation between the samples into account appears to be intractable in any case. However, it is a good idea to mention this in the thesis for clarity.
6. In page 42, you indicate that steps 1-3 remain the same. Is summing Y_{k,l} sill the best approach? Justify in 2-3 lines.

Once again, I would like to commend the student on his effort. His analysis is very mature, and his thesis is exceptionally well written.