Reviewer #1:  
  
At the end of section 2, it is said: "Therefore, based on the understanding of the model and the characteristics of the measured data, manually adjust the  
parameters to determine the order of magnitude of the parameters, making the trend of the model reasonable. Then the Parameter Estimator function is used in the Simulink Design  
Optimization toolbox for small-scale parameter optimization."  
The authors should better explain this point. Refering a MATLAB toolbox is not an appropiate justification in a cientific journal.  
What to you exactly tune ? How do you do it ? which cost function do you optimize ?

Added explaination about MATLAB toolbox algorithm.  
  
I don't understand section 3. The authors refer to an observer, but what they propose has little to do with what I understand by an observer.  
The observer here refers to the estimation function that takes in sensor data.  
The authors assume one state is known to estimate the next? How do you know that the initial state is correct?

The initial state value in paper comes from choosing the set of value that’s closet to actual values.  
What sensory information do the authors use?

This experiment uses the following sensors:

The Air pressure on hydrogen/air side, including input & output pressure. Temperature on both side, including input & output pressure. The system’s power output, and average voltage/current of each cell unit.   
Authors should make an effort to properly position their work in the literature. There are various works in the literature that use observers to estimate the state of fuel cells and, from them, the humidity of the membranes. But they are not cited in the references nor are the results compared with theirs.  
Ref 31/32/33 were introduced to demonstrate previous works.  
  
   
  
  
Reviewer #2: Water management is one of the key approaches to enhance the durability of PEMFC. Therefore, it is necessary to identify the internal water state of the PEMFC accurately and quickly and control it within a reasonable range. The current paper verifies simulation, experiment and the simplified mechanism model of PEM containing water in ionomer, liquid water and water vapor. Based on the simulation, the internal water state trend of the PEMFC was analyzed and can accurately estimate the water state inside PEMFC, contributing to the advancement of PEMFC technology and its wide application in the automotive field. Thus, the work can be considered relevant to the area, so, I recommend the publication to the Energy Conversion and Management after minor revision:  
1) Page 5, Information about reason of choosing certain measurement noise and process noise are missing and needs corresponding literature.

Added literature supporting the choice of measurement.  
2) Page 5, description, and physical explanation of Figure 1 are needed.

图像的解释需要添加  
Reviewer #3: Dear Author,  
In order to quickly identify the water state in PEMFC, a simplified model of the mechanism of proton exchange membrane containing water in ionomers, liquid water and water vapor is established. The simplified mechanism model is verified by simulation and experiment. Then, the influence of measurement noise and process noise setting values on the performance of the observer is analyzed. The article has the following features:  
1. A simplified mechanism model of PEM containing water in ions, liquid water and water vapor is established.  
2. Influence of measurement noise and process noise setpoints on observer performance.  
3, noise variance 10-4, process noise 10-8.  
4. Internal state observer based on membrane model and particle filter algorithm.  
5, the change trend of the internal water state is simulated.  
6. The performance of the state observer based on voltage, high frequency resistance and sensor fusion is compared.  
To sum up, the research work presented in this paper is relatively complete, the model verification is highly accurate, and the innovation is strong, which is worthy of publication in Energy Conversion and Management. However, before this, some questions need to be explained:

1- What does the simplified model do? What is the most prominent role of this simplified model in monitoring internal water status compared to existing studies? Can it be put into practical production applications?  
2- What are the meanings of online and offline? What is the difference in the measurement process?

Online estimation can use new data from model during execution, it can capture changes of model instantly and produce better results.  
3- The existing measurement method does not distinguish the flow channel, GDL, CL, how did the existing research measure?  
4- FIG. 5, What was the cause of the sudden change in the average voltage in the 80s?

The model’s estimation performs worse when voltage is unstable, and experiment 3 has unstable voltage.  
5- Please explain why Observer-HFR and Observer-Fusion observations of membrane water content and CL liquid water volume fraction are close.  
HFR handles higher dimension data better, and Sensor fusion performs better when input data comes from multiple sensors. In this research two methods has similar performance due to the small number of sensors and relatively lower dimension of data. However the sensor fusion method can adapt better with additional sensors whereas HFR methods may lose accuracy due to extra source of data.  
  
  
Reviewer #4: The long, detailed manuscript presents the development of a sensor for PEM fuel cell based on particle filter. The overall investigation comprises an effective model for the fuel cell, a few dedicated experiments, the methodology used for the state observer, and the results, namely the efficiency of observers relying on different statistical criteria, on some variables (or states) of the fuel cell. The paper seems of high relevance in the domain, the structure of the paper appears appropriate, as well as the illustrations. The language is in overall OK to me, but should nevertheless be improved : (i) some words used in the MS sound not suitable for the targeted meaning ; (ii) the position of adverbs has to be checked and corrected in some places ; (iii) tense of verbs as in section 5. More detailed questions/comments/suggestions are listed below.   
\* Abstract : a couple of concepts mentioned is not straightforward for any reader e.g. « The state online indirect method .. », « sensor fusion ». Besides, is the abstract not somewhat too long ?

Removed useless introduction for online indirect method.  
\* The list of symbols is of real use in the paper, but a few are missing such as « omega », or « MAPE ».

The omega symbol in this paper is used as an unit of measurement.

The MAPE explanation is added to the nome­nclature.  
\* Numerical modelling, page 5. The assumptions are given. Does assumption 7 means that the various cells in the stack behave the same, i.e. with the same voltage, the same relative humidity and water pressures at various locations ?  
\* Section 2.1.2 what does « .. where the size of the surface tangential force is … » mean ?

Removed “the size of”, the force is directly related to gas flow rate.   
\* Besides, the authors mention vlig in m/s as the liquid flow rate. Why not speak on liquid velocity ?

Renamed liquid flow rate to liquid velocity  
\* Rel (13): Could the exponent 4 for variable s be justified ?

The equation is referenced from Hu’s research in reference 29.  
\* Below rel. (15), the viscosity has to be « µ ».

Typos has been fixed, removing the duplicating “µ”  
\* Section 2.1.6. « The mutual conversion » : is not it actually a phase conversion rate ?

It’s a phase conversion state, the article used mutual conversion to better demonstrate the focus on liquid and gas.

\* The description of Schroeder's paradox is interesting, but the explanation sentence should be rephrased.

Reorganized the order of explanation.  
\* Rel. (35) : could the factor 2 for variable s be explained ?

The equation is referenced from Dullien’s research in reference 37.  
\* General comment for a recurrent point : in many places in the paper, the expression of a variable is introduced in an sentence, the expression is given, and followed by « where X is the variable … ». The lengthy, repetive structure could be easily replaced by introducing the expression of variable X (here give its name !) before this expression. Besides, the recurrent expression « is represented as follows » could be (i) improved, and sometimes be rewritten with alternative words.  
\* Does rel. (55) apply for any polysulfonated membrane, in particular for the membrane used in this work ?

This equation is referenced from Jiao’s work in reference list [41]. The parameter of this equation is applied to all PEMs.  
\* Table 1 : could it be specified that the temperature was at 65°C (338.15 K) ?

Add extra constraint to table header.  
\* Rel. (62) : what does wk(i) represent ?

The wk^(i) is used to represent the state of particle in step K, the state wk^(i) is determined by the previous state wk^(i-1)  
\* Page (19) « measurement noise and process noise ». How are they defined ? How are they generated ?

The definition and generation were both discussed in Section 5.2  
\* Section 4. Tests consisted in a sudden change in air flow rate (or more precisely in rotation speed of something) and at measuring the cell current and the high frequency impedance. OK, but was it done at a fixed, specified voltage ?

The voltage is restricted in a fixed level, but minor change could still happen, especially in experiment 3, which caused unstable estimation result of the model.  
\* Table 4 : What does « CMP speed » mean ?

“CMP” is replaced by “Compressor” in Table 4.  
\* The presentation of section 5 is not straightforward for a non-specialist of observers, with a couple of not fully clear concepts e.g. « observer fusion », however, it sounds really interesting since based on a solid methodology (just a comment).

The Observer-Fusion is a simplification for “observer based on sensor fusion”, it’s compared with “observer based on HFR”.  
To conclude, the paper could be published after minor revision, most of them for the sake of an easier reading by non-specialists of the topic.