Question text

What would you quantify as a rich perturbation in terms of magnitude or % above standard value..

how do you decide on the order of the IBR model in the estimation?

In the analyses that you have presented, why do you neglect the DQ or QD elements of the impedance models of the converter?

What is your view of RMS PLL models - do you study balanced-rms solutions and unbalanced-rms solutions ? Given that disturbances are unbalanced ?

Can you please clarify the input model you were using when estimating to capture the actual oscillatory behavior? An RMS generic model?

When injecting the PRBS into the system for identification, will it be attenuated by system components, such as transformers that can act as low-pass filters?

is the RMS+ model is also implemented in the dq reference frame?

You showed GFM having negative damping for SCR around 7-10. This seems very low. Is it representative of real GFM controls?

Slide 8 & 9, IBR is modelled as voltage injection, will model it as Norton eqv. make any difference?

Is oscillation detection and response a mitigation being considered in with the manufacturers?

Could you please provide references for data-driven SSO event analysis?

Answers

Both amplitude and frequency content of the perturbation signal are important. In simulation the amplitude can be low to preserve linearity, but in a real system it must be above the noise level while staying close to the operating point.

One way is to decide is based on the Hankel singular values

Only DD and QQ were shown on the slide, DQ and QD could have been shown as well

Small-signal stability analysis typically considers balanaced condition

We generally use EMT-dq model which was benchmarked against EMT-abc for SSO

There are various low pass filters in the IBRs as well. A rich perturbation like PRBS or multi-sine is expected to excite the dominant modal behavior.

Yes

GFMs can be stable up to higher SCRs if (say) the voltage control is slower, virtual output impedance is used etc.

Similar approach can be applied

At the moment, our work is mainly with system operators (NESO), but SSO mitigation through IBR control is OEM's territory and we need to get more involved with them.

https://ieeexplore.ieee.org/document/9989426