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Damping of Interarea Modes using a GMVC-based WAPSS

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Abstract: This paper presents the implementation of a GMVC-based WAPSS to damp the interarea modes of power systems. The choise for the GMVC to tackle this problem lies on the fact that it can be used to compensate the time delay due to the latency of the transmission system in a more natural way than other controllers. The paper shows that it is possible to improve system's closed-loop stability since its behavior is the same as if the time delay is not regarded. Simulation results with Kundur's System prove that a latency of 1 second at a conventional WAPSS might lead system's power to oscillate for 50 seconds for a short-circuit at the transmission line, whereas the oscillation decreases to only 5 seconds if the GMVC-based WAPSS is implemented.

Keywords: Power Systems, Wide-Area Power System Stabilizer, Generalized Minimum Variance Controller, Interarea Modes, Predictive Control.

1. INTRODUCTION

According to Taylor (1994), power systems are the most complex structure ever developed by man. The connection of several generators, prime movers, transmission lines, busbars, etc., led to very intrincate and sophisticate systems. It is possible to assure that the larger the power system, the less stable it will be if no counteraction is taken.

The interarea modes, which are electromechanical phenomena, are known to be one of the most threatening types of oscillating modes in power systems. They are represented by low frequency oscillations (0.1-0.7 Hz) on the power exchange between two or more generating areas. The active power exchange causes the generators of one area to oscillate against the generators in other areas, *i.e.*, during transients the generators of different areas rotate with contrasting phases, resulting in frequency deviations that could collapse the whole system (Machowski et al. (2011)).

The origin of most of the cited interarea modes are known, and therefore counteractions were already been taken in order to avoid or at least to mitigate them. Despite researches that cope with damping of these oscillations through Flexible AC-Transmission Systems (FACTS) (see, *e.g.*, Mithulananthan et al. (2003), Lei et al. (2013)), the most used device for tackling the interarea modes is still the Power System Stabilizer, short PSS (Kundur et al. (1994)), which is a device connected to the input of the Automatic Voltage Regulator (AVR) and serves to damp out undesired oscillations. The PSS was first developed to damp local modes out (0.7-2 Hz). However, when the interarea modes were finally identified as an important problem in power system stability, it was also implemented for the damping of these modes, obtaining well-accepted results over the years through several different approaches (see, e.g, Kundur et al. (1989), Dai and Ghandakly (1995), Kutzner (1999), Ba Muquabel and Abido (2006)).

Nonetheless, the local modes can be easily damped through the usage of local PSSs since these modes have a stronger impact on the states of the generator on which it concerns. On the other hand, interarea modes of very low frequencies are hardly damped with local PSSs due to its mechanical characteristics (Milano and Anghel (2011)). Also, the analysis of the participation factors and eigenvectors might show that a given interarea mode is better observable in an area but better damped in another (Patel et al. (2018)). Based on this fact several researchers investigated the possibility of using signals from other areas to increase damping in comparison to the local PSS.

The Wide-Area Measurement Systems (WAMS) were developed exactly to ease the usage of these remote signals of wide geographical area through satellites, which ended up enabling the design of the so-called Wide-Area PSS, or simply WAPSS (Chaudhuri et al. (2004)). Patel et al. (2018) state that WAPSSs might use 4-20 times less control effort than the conventional (local) PSSs.

However, one issue to be tackled by the WAPSS is the latency of the signals from distant machines, which depends on the distance as well as on the used technology. This latency introduces a time delay on the control loop that might harm system's overall stability (Milano and Anghel (2011)).

The common approach is to model the power system with time delay using Padé's approximations and then designing the WAPSS based on continuous time models. Chaudhuri et al. (2004) used a Smith Predictor to compensate the delay, with an approximation for the $e^{s\tau}$ term. Zhang et al. (2012) used a adaptive algorithm to identify and compensate it. Yao et al. (2014) present a predictive approach based on the GPC, resulting in a smooth control signal. Ghosh and Senroy (2012) and Patel et al. (2018) study the effect of synchronized and non-synchronized time delays over the WAPSS, highlighting that using non-sychronized signals increases the overall stability of the power system.

Nonetheless, an even more trivial approach that is hardly found in literature is the usage of power plant's digital model to design the WAPSS, likewise in (Yao et al. (2014)). This synthesis deals with the time delay in a simpler and more intuitive way than using the continuous time modeling. Moreover, the digital approach enables the designer to use advanced control techniques, such as predictive, adaptive, stochastic, among many others.

Towards this, the present paper proposes a predictive approach to deal with the signal latency. Unlike Yao et al. (2014), which worked with the GPC in a SISO way and obtained a smooth control signal, in this work the algorithm to be implemented is the Generalized Minimum Variance Controller (GMVC) (Clarke and Gawthrop (1975)).

This controller is chosen due to its intrinsic ability to deal with the time delay. Also, Trentini et al. (2016) have shown that any linear controller posed in the RST structure might be converted to a GMVC. The main advantage of this technique lies on the fact that the time delay may be entirely compensated whereas closed-loop's dynamics remains the same. In other words, this approach restores system's stability without changing its closed-loop behavior due to the cancelation of the time delay.

The technique eases controller's project since it can be designed regardless the latency, which is tackled by the GMVC predictor.

In order to present this ideia, this paper is split into the following: Section 2 shows the WAPSS equating in the RST structure. Section 3 presents the WAPSS designed via the GMVC synthesis. Section 4 details the design of the GMVC-based WAPSS, whereas Section 5 shows the evaluation of the presented technique through simulation results for Kundur's System.

2. WAPSS IN THE RST STRUCTURE

This section shows how a generic regulated power system might be represented in the RST fashion, which is a standard structure for linear digital controllers (Landau (1998)). It counts on three arbitrary polynomial filters given by,

$$\begin{aligned} R(q^{-1}) &= r_0 + r_1 q^{-1} + \ldots + r_{n_a} q^{-n_r} \\ S(q^{-1}) &= s_0 + s_1 q^{-1} + \ldots + s_{n_b} q^{-n_s} \\ T(q^{-1}) &= t_0 + t_1 q^{-1} + \ldots + t_{n_c} q^{-n_t}, \end{aligned}$$

which are responsible for plant's output closed-loop behavior and are posed in the way shown in Fig. 1.

In the figure, $y(k)$, $y_r(k)$ and $u(k)$ are sampled output, controller reference and control signal, respectively. The plant is represented by generic polynomial model with coefficients,

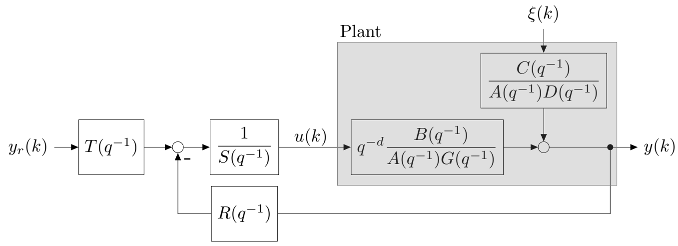

Fig. 1. RST structure for a plant represented by a generic SISO polynomial model.

$$\begin{aligned} A(q^{-1}) &= 1 + a_1 q^{-1} + \ldots + a_{n_a} q^{-n_a} \\ B(q^{-1}) &= b_0 + b_1 q^{-1} + \ldots + b_{n_b} q^{-n_b} \\ C(q^{-1}) &= 1 + c_1 q^{-1} + \ldots + c_{n_c} q^{-n_c} \\ D(q^{-1}) &= 1 + d_1 q^{-1} + \ldots + d_{n_d} q^{-n_d} \\ G(q^{-1}) &= 1 + g_1 q^{-1} + \ldots + g_{n_g} q^{-n_g}, \end{aligned}$$

being d the sample delay, q^{-1} is the backward shift operator and $\xi(k)$ is a Gaussian white noise sequence, which might be an external disturbance too.

Now, let us regard the plant as a whole generic power system with its output being the speed difference of generators i and j ($y(k) = \omega_{ij}(k)$) and its input being WAPSS's output signal $u(k) = v_{\mathrm{pss}_i}(k)$. This formulation poses a regulation problem since there is no reference change for the speed. Therefore, the WAPSS control law is given by,

$$v_{\mathrm{pss}_i}(k) = -\frac{R(q^{-1})}{S(q^{-1})}\omega_{ij}(k), \tag{1}$$

which results in the following closed-loop expression,

$$\omega_{ij}(k) = \frac{CGS}{ADGS + q^{-d}BDR}\xi(k), \tag{2}$$

where the argument q^{-1} is omitted for the sake of readibility.

To be noticed is that the time delay d appears explicitly in the characteristic polynomial, which means that the stability margins of the whole power system might be harmed. One must keep this information in mind when analyzing the GMVC, which is presented in the next section.

3. GMVC-BASED WAPSS

This section reviews briefly the theory behind the GMVC in order to formulate the proposed WAPSS. For a deeper understanding of it we recommend the reading of Clarke and Gawthrop (1975); Doi and Mori (2002); Silveira and Coelho (2011).

The GMVC was developed from the Minimum Variance Regulator (MVR) first introduced by Åström in the 1970s. Its generalized output is,

$$\phi(k) = P(q^{-1})y(k) - T(q^{-1})y_r(k+d) + Q(q^{-1})u(k), \tag{3}$$

with $P(q^{-1})$, $T(q^{-1})$ and $Q(q^{-1})$ being arbitrary weighting filters for system's output, reference and control signal respectively. Remark that for the WAPSS, $y(k) = \omega_{ij}(k)$, $u(k) = v_{\text{pss}_i}(k)$ and $y_r(k+d) = 0$.

The generalized output $\phi(k)$ is posed into a stochastic optimization problem of minimizing the GMV cost function,

$$\mathbf{J} = \mathbb{E}\left[\phi^2(k+d)\right], \tag{4}$$

while $\mathbb{E}[.]$ denotes the mathematical expectation operator.

According to Fig. 1, the plant is given by,

$$A(q^{-1})\omega_{ij}(k) = q^{-d}\frac{B(q^{-1})}{G(q^{-1})}v_{\text{pss}_i}(k) + \frac{C(q^{-1})}{D(q^{-1})}\xi(k). \tag{5}$$

Shifting Eq. 5 d-steps ahead and remembering that $P(q^{-1})$ multiplies the output $y(k)$ in Eq. 3, one obtains,

$$\begin{aligned} P(q^{-1})A(q^{-1})\omega_{ij}(k+d) &= \frac{P(q^{-1})B(q^{-1})}{G(q^{-1})}v_{\text{pss}_i}(k) \\ &+ \frac{P(q^{-1})C(q^{-1})}{D(q^{-1})}\xi(k+d). \end{aligned} \tag{6}$$

Clearly $\xi(k+d)$ is unknown because it represents the future of the disturbance, and therefore it can be represented by present and future parts:

$$\begin{aligned} \frac{P(q^{-1})C(q^{-1})}{A(q^{-1})D(q^{-1})}\xi(k+d) &= \frac{F(q^{-1})}{A(q^{-1})D(q^{-1})}\xi(k) \\ &+ E(q^{-1})\xi(k+d), \end{aligned} \tag{7}$$

whereas its Diophantine equation, *i.e.* a polynomial equality which arises, is given by,

$$P(q^{-1})C(q^{-1}) = A(q^{-1})D(q^{-1})E(q^{-1}) + q^{-d}F(q^{-1}). \tag{8}$$

being $E(q^{-1}) = 1 + e_1 q^{-1} + \cdots + e_{n_{d-1}} q^{-d+1}$ and $F(q^{-1}) = f_0 + f_1 q^{-1} + \cdots + f_{n_f - 1} q^{-n_f + 1}$, with $n_f = n_p + n_c$.

Using only the known data, the predicted output $\hat{\omega}_{ij}(k+d|k)$ is,

$$\begin{aligned} P(q^{-1})\hat{\omega}_{ij}(k+d|k) &= \frac{P(q^{-1})B(q^{-1})}{A(q^{-1})G(q^{-1})}v_{\text{pss}_i}(k) \\ &+ \frac{F(q^{-1})}{A(q^{-1})D(q^{-1})}\xi(k). \end{aligned} \tag{9}$$

Thus, the current stochastic signal $\xi(k)$, obtained from the estimation error is,

$$\xi(k) = \frac{P(q^{-1})}{E(q^{-1})}\left[\omega_{ij}(k) - \hat{\omega}_{ij}(k|k)\right]. \tag{10}$$

Substituting Eq. 10 into 9 and after some algebraic manipulations, the d-steps ahead Minimum Variance Predictor (MVP) turns to,

$$\begin{aligned} \hat{\omega}_{ij}(k+d|k) &= \frac{B(q^{-1})D(q^{-1})E(q^{-1})}{P(q^{-1})C(q^{-1})G(q^{-1})}v_{\text{pss}_i}(k) \\ &+ \frac{F(q^{-1})G(q^{-1})}{P(q^{-1})C(q^{-1})G(q^{-1})}\omega_{ij}(k). \end{aligned} \tag{11}$$

The GMVC control law is thus obtained through the minimization of $\mathbf{J}$ w.r.t $u(k)$ with $\mathbb{E}\left[\phi^2(k+d)\right] = \hat{\phi}^2(k+d)$, resulting in,

$$v_{\text{pss}_i}(k) = -\frac{FG}{BDE + CGQ}\omega_{ij}(k), \tag{12}$$

with the argument q^{-1} omitted for the sake of readibility.

At last, the closed-loop polynomial is obtained through the substitution of Eq. 12 into 6. Using also Eq. 8, after some algebraic manipulations, one finds:

$$\omega_{ij}(k) = \frac{CGQ + BDE}{ADGQ + BDP}\xi(k). \tag{13}$$

One may clearly see that the time delay d is entirely compensated in the characteristic polynomial, which means that it does not influence the system stability.

Notice also that if one sets $Q(q^{-1}) = S(q^{-1})$ and $P(q^{-1}) = R(q^{-1})$ the characteristic polynomials of Eq. 2 and 13 are the same, except for the time delay. It eventually means that the dynamics of both systems might be similar if the time delay is not regarded.

In other words, one can design conventional WAPSSs using all the already known techniques while the implementation may be based on the GMVC in order to overcome the time delay issue.

Next section presents the implementation of the proposed WAPSS followed by dynamic simulations of a benchmark power system.

4. DESIGN OF THE GMVC-BASED WAPSS

From the last sections, the plant polynomials $A(q^{-1})$, $B(q^{-1})$, $C(q^{-1})$, $D(q^{-1})$ and $G(q^{-1})$, as well as the GMVC ones $E(q^{-1})$, $F(q^{-1})$, $P(q^{-1})$ and $Q(q^{-1})$ are to be defined. However, as already cited, $Q(q^{-1}) = S(q^{-1})$ and $P(q^{-1}) = R(q^{-1})$, which means that $R(q^{-1})$ and $S(q^{-1})$ must be found.

Starting from the most fundamental PSS structure shown in Fig. 2, with K, τ_w, τ_1 and τ_2 being respectively the PSS gain, wash-out time constant and the lead and lag time constants.

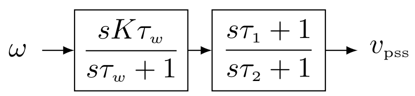

Fig. 2. PSS with one lead-lag block.

Defining,

$$s := \frac{1}{t_s}(1 - q^{-1}) \qquad \text{(implicit Euler method)},$$

for converting the PSS to the digital domain and being t_s the sample time, the RST structure is obtained after some algebraic manipulations, which results in,

$$\begin{aligned} &\underbrace{\left[t_s^2 + (\tau_w + \tau_2)t_s + \tau_w\tau_2\right]}_{s_0} v_{\text{pss}}(k) + \cdots \\ &\cdots + \underbrace{\left[-(\tau_w + \tau_2)t_s - 2\tau_w\tau_2\right]}_{s_1} v_{\text{pss}}(k-1) + \underbrace{\tau_w\tau_2}_{s_2} v_{\text{pss}}(k-2) = \\ &\underbrace{K\tau_w\,(t_s + \tau_1)}_{r_0}\omega(k) + \underbrace{K\tau_w\,(-t_s - 2\tau_1)}_{r_1}\omega(k-1) + \cdots \\ &\cdots + \underbrace{K\tau_w\tau_1}_{r_2}\omega(k-2), \end{aligned} \tag{14}$$

being,

$$R(q^{-1}) = r_0 + r_1 q^{-1} + r_2 q^{-2},$$
$$S(q^{-1}) = s_0 + s_1 q^{-1} + s_2 q^{-2},$$
$$T(q^{-1}) = 0,$$

which basically defines also $P(q^{-1})$ and $Q(q^{-1})$.

A modified version of Kundur's Two-Area System (Kundur et al. (1989)) is chosen to be the plant. The system is shown in Fig. 3, which is composed by two generating areas separated by two weak transmission lines between busbars 7 and 9. Each generating area has two other generators. The PSS of generator 4 is disconnected in order to highlight an interarea mode of aproximately 0.6 Hz.

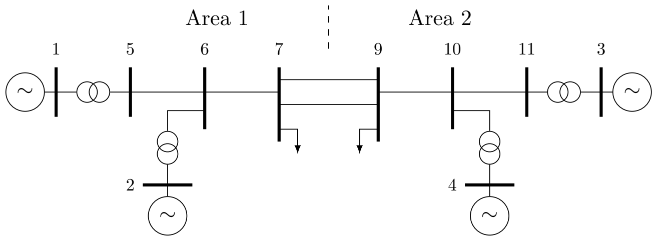

Fig. 3. Kundur's Two-Area System.

The geometric approach (Hamdan and Elabdalla (1988)) shows that ω_{23} is a suitable signal to be used, with the proposed WAPSS being applied on generator 2. Following this, the plant linearization is performed, which provides a 58$^{\text{th}}$-order model. The terminal voltage reference at busbar 1 is regarded as an external disturbance, with ω_{23} being plant's output. It leads the system to an ARMAX (*Auto-Regressive Moving Average with eXogenous input*) model, being $D(q^{-1}) = G(q^{-1}) = 1$, with $A(q^{-1})$, $B(q^{-1})$ and $C(q^{-1})$ completely defined.

Finally, $E(q^{-1})$ and $F(q^{-1})$ are calculated through the Diophantine Equation (Eq. 8).

5. SIMULATION RESULTS

Using Kundur's System, two scenarios are simulated in order to evaluate the proposed WAPSS: a 5% step at the voltage reference of busbar 1, and a short-circuit in the middle of one of the transmission lines between busbars 7 and 9. The former emulates a linear behavior of the power system whereas the latter is aimed to excite system's nonlinearities in order to evaluate the proposed WAPSS.

For the sake of comparison, each scenario is simulated with local PSS, conventional WAPSS and also with the GMVC-based WAPSS.

Also, in order to highlight the difference between the WAPSSs (*i.e.*, conventional and proposed ones), the time delay is set to one second. At a first glance this value might seem too high, however one must observe that, for Kundur's System, small time delays ($\gtrsim$ 400 ms) do not impact significantly on system's stability. Therefore, the chosen value is used here only to emphasize the improvement which the GMVC-based WAPSS may give to system's overall stability.

The variables to be analyzed are speed, terminal voltage, electric power and PSS's output signal. Also, the signal ω_{23} is shown. For a better readibility, only signals of generator 3 are shown, since the interarea modes are easily identifiable at this machine due to the distance from the voltage change (generator 1). Concerning the short-circuit simulation, any machine can be analyzed since the fault occurs at the middle of the power system.

Regarding the PSS output, the analysis are done on the device applied to generator 2, therefore v_{pss_2} is the signal to be analyzed.

Figure 4 shows the results for the 5% step voltage at generator 1 at $t = 1$ s. All the values are in p.u. units.

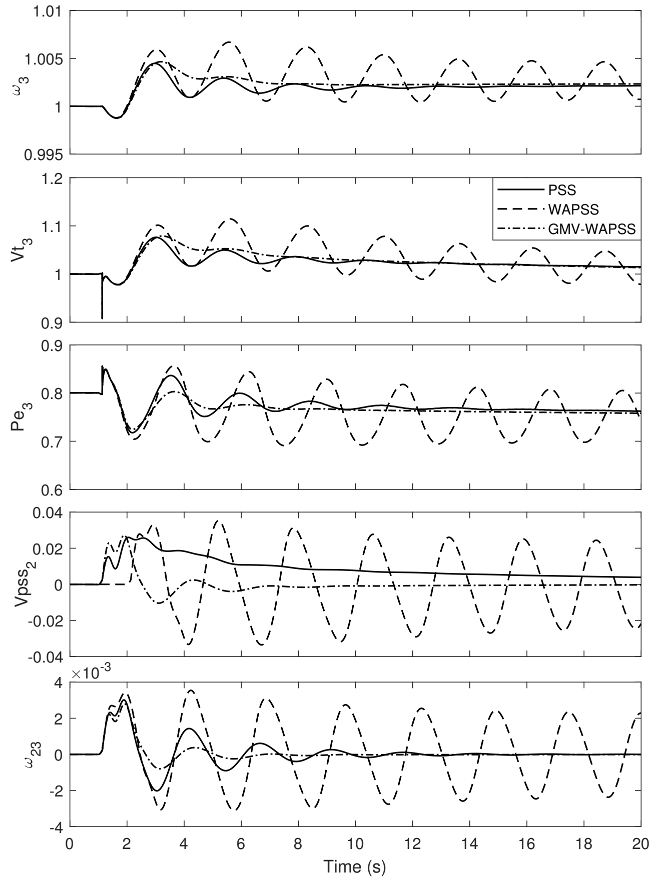

Fig. 4. Step of 5% at the reference voltage of generator 1.

Observe that an 1 s time delay makes the local PSS to perform better than the conventional WAPSS. The former damps out the 0.6 Hz interarea oscillation in about 10 s, whereas the latter takes about 50 s. The acting of v_{pss_2} for the conventional WAPSS starts one second after the change in the reference voltage of busbar 1 due to the synchronization time, which harms the overall stability of the power system.

On the other hand, the GMVC-based WAPSS is able to damp out the power oscillations in only 5 s. The analysis of signals ω_{23} and v_{pss_2} explains the results for the speed, terminal voltage and electric power at generator 3. Worth citing is GMVC-based WAPSS's output, where it is noticeable that, differently from the conventional WAPSSs, its acting starts at the same time of the local PSS, *i.e.*, at $t = 1$ s. This behavior is expected according to the GMVC equating presented in Sec. 3. Since the time delay between signals ω_2 and ω_3 does not influence the proposed WAPSS output, it is able to help on the damping of the interarea modes more efficiently.

The short-circuit simulation is shown in Fig. 5, where the fault time is set to 200 ms.

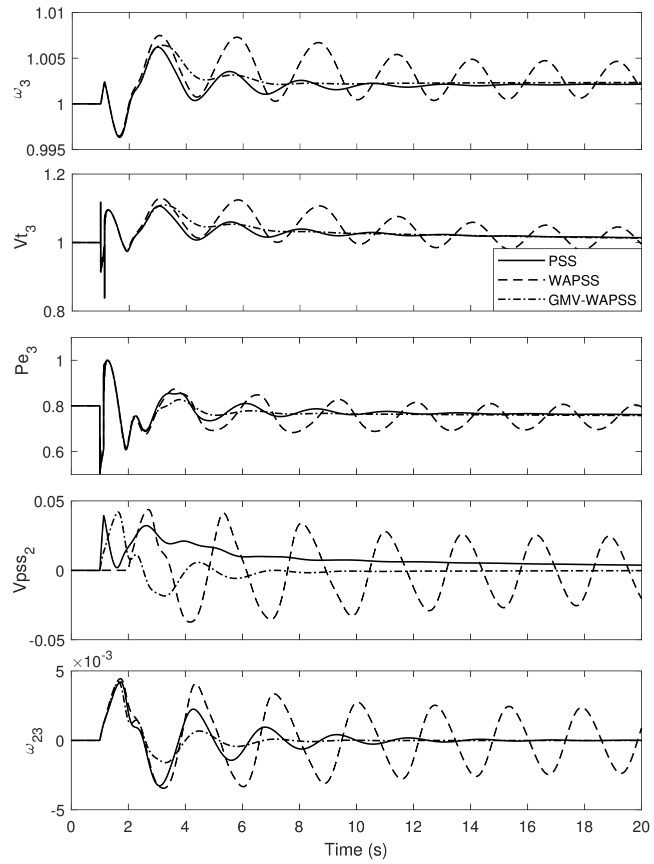

Fig. 5. Short-circuit between busbars 7 and 9.

The figure shows that, by means of stability, the results obtained with the short-circuit simulation are similar to that obtained with the 5% step at the reference voltage of generator 1. The local PSS stabilizes the power after 10 s, the conventional WAPSS takes about 50 s and the proposed WAPSS needs less than 5 s.

Moreover, GMVC-based WAPSS outperforms the conventional WAPSS by all means for the study case. Again, it is possible to observe that the proposed WAPSS output v_{pss_2} starts acting 1 s before the conventional one, which justifies the increase of system's overall stability.

6. CONCLUSION

This paper has shown that inherent latency issues of WAPSS may be overcome with a GMV-based design. It presents comprehensive results that comply with the MV theory, *i.e.*, system's time delay might be fully compensated if system's (identified) model is known.

Further works will cope with larger power systems and with different PSSs' structures, like the PSS2B and PSS4B.

REFERENCES

Ba Muquabel, A.A. and Abido, M.A. (2006). Review of conventional PSS design methods. In *GCC Conference IEEE*.

Chaudhuri, B., Majumder, R., and Pal, B.C. (2004). Wide-area measurement-based stabilizing control of power system considering signal transmission delay. *IEEE Transactions on Power Systems*, 19(4), 1971–1979.

Clarke, D.W. and Gawthrop, P.J. (1975). Self-tuning controller. In *Proceedings of the Institution of Electrical Engineers*, volume 122, 929–934. IET.

Dai, J. and Ghandakly, A. (1995). A decentralized adaptive control algorithm and the application in power system stabilizer (PSS) design. In *Industry Applications Conference, 1995. Thirtieth IAS Annual Meeting, IAS '95., Conference Record of the 1995 IEEE*, volume 2, 1641–1648 vol.2.

Doi, M. and Mori, Y. (2002). A study on robust asymptotic tracking property for generalized minimum variance control. In *Proceedings of the American control conference*, 1472–1477.

Ghosh, S. and Senroy, N. (2012). A comparative study of two model order reduction approaches for application in power systems. In *Power and Energy Society General Meeting, 2012 IEEE*, 1–8.

Hamdan, A. and Elabdalla, A. (1988). Geometric measures of modal controllability and observability of power system models. *Electric power systems research*, 15(2), 147–155.

Kundur, P., Klein, M., Rogers, G., and Zywno, M. (1989). Application of power system stabilizers for enhancement of overall system stability. *Power Systems, IEEE Transactions on*, 4(2), 614–626.

Kundur, P., Balu, N.J., and Lauby, M.G. (1994). *Power system stability and control*, volume 7. McGraw-Hill New York.

Kutzner, R. (1999). A robust H∞ PSS with enlarged damping range. In *Power Engineering Society Summer Meeting, 1999. IEEE*, volume 1, 53–57. IEEE.

Landau, I. (1998). The RST digital controller design and applications. *Control Engineering Practice*, 6(2), 155–165.

Lei, B., Fei, S., and Zhai, J. (2013). Coordinated control of static synchronous compensator and automatic voltage regulator in multi-machine power systems using pseudo-generalized Hamiltonian theory. *Proceedings of the Institution of Mechanical Engineers, Part I: Journal of Systems and Control Engineering*.

Machowski, J., Bialek, J., and Bumby, J. (2011). *Power system dynamics: stability and control*. John Wiley & Sons.

Milano, F. and Anghel, M. (2011). Impact of time delays on power system stability. *IEEE Transactions on Circuits and Systems I: Regular Papers*, 59(4), 889–900.

Mithulananthan, N., Canizares, C.A., Reeve, J., and Rogers, G.J. (2003). Comparison of PSS, SVC, and STATCOM controllers for damping power system oscillations. *Power Systems, IEEE Transactions on*, 18(2), 786–792.

Patel, A., Ghosh, S., and Folly, K.A. (2018). Inter-area oscillation damping with non-synchronised wide-area power system stabiliser. *IET Generation, Transmission*

& Distribution, 12(12), 3070–3078.

Silveira, A. and Coelho, A. (2011). Generalised minimum variance control state-space design. *Control Theory Applications, IET*, 5(15), 1709–1715.

Taylor, C.W. (1994). *Power system voltage stability.* McGraw-Hill.

Trentini, R., Silveira, A., Bartsch, M., Kutzner, R., and Hofmann, L. (2016). On the design of stochastic RST controllers based on the Generalized Minimum Variance. In *Proceedings of the 11th UKACC International Conference on Control.* Belfast.

Yao, W., Jiang, L., Wen, J., Wu, Q., and Cheng, S. (2014). Wide-area damping controller for power system interarea oscillations: A networked predictive control approach. *IEEE Transactions on Control Systems Technology*, 23(1), 27–36.

Zhang, P., Yang, D., Chan, K., and Cai, G. (2012). Adaptive wide-area damping control scheme with stochastic subspace identification and signal time delay compensation. *IET generation, transmission & distribution*, 6(9), 844–852.