Contract Violation case of Load Frequency Control of interrelated power system with PI Controller

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Abstract: Classical linear as well as non-linear software design approaches are frequently incompatible and unfeasible when put on the contracted issues. Problems occur due to either the quantity of calculation obligatory rapidly develops riotous as the scope of tricks surges or the contract violates the essential supposition. In contract violation case, the objective function is not uninterruptedly differentiable or totally defined because of less knowledge that occurs in real world requests.

Keywords: Load Frequency control, Contract violation, PI controllers.

1. Introduction

The significant role of an Electrical power in the life of community is to develop numerous segments of economy. Today, the current economy is entirely in need of electricity as a rudimentary unit. The technical rebellion moves every feature of current life. Rapidly emerging computer skills are altering the work atmosphere for power causes working by values and producers. Developing computer software allows quite precise project of power system components or networks and amenities, more urbane operational approaches that effect in high system dependability. Though computational methods have showed valuable in overall purpose of optimization, these seem mainly pertinent for addition of non-linearly constrained optimization issues.

2. Load Frequency Control Problem

Load Frequency Control (LFC) issue is the extreme critical and novel arena of investigation in interrelated power systems has a profound past in the power system process. The generators functioned in service zone swing the speed steadily for corresponding the power angles and frequency to precise quantity of fixed and enthusiastic circumstances together. It is obligatory to accomplish the frequency at definite and adequate restrictions but nonstop dissimilarity in load can't be overlooked due to instable nature. A moral load frequency control system has the ability to equilibrium the tie line power and system frequency within their limits.

3. Two Area Hydro Thermal Transfer Function

The two area Hydro Thermal transfer function is revealed in Fig. 1 in which two different areas like Hydro and Thermal areas are connected with power system. The total power generation in an area is equal share of generated power by Hydro and Thermal power plant in respective areas.

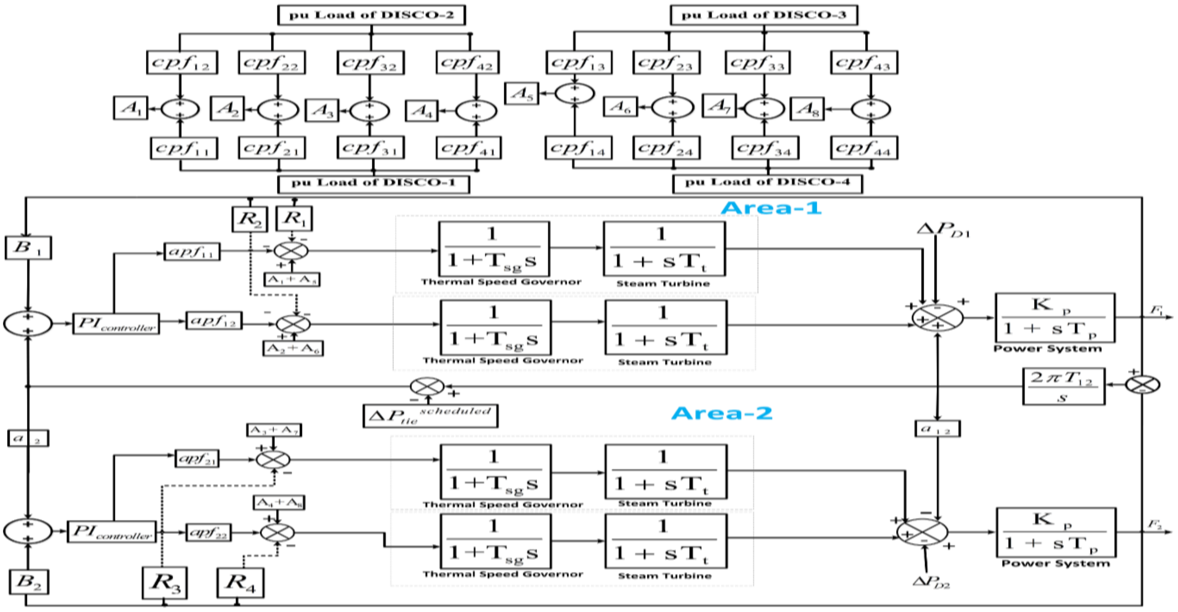

Fig. 1: Two area Hydro Thermal Transfer Function

4. Contract Violation case

The Bilateral Contract epitomizes the reciprocated, jointly argument of tapered power among DISCO and GENCO. As per this contract, GENCOs and DISCOs exchange power with respect to prescribed contract to satisfy the load requirement for consistent power system operation[28]. The Distribution Participation Matrix signifies bilateral contract for each DISCO and GENCO with entire load requirement in area 1 becomes 0.015p.u MW due to additional claim by DISCOs. The DISCO needs an additional power of 0.003 p.u MW as per Contract-Violation case which can be displayed as shown below:

$$DPM = \begin{bmatrix} 0.5 & 0.25 & 0 & 0.3 \\ 0.2 & 0.25 & 0 & 0 \\ 0 & 0.25 & 1 & 0.7 \\ 0.3 & 0.25 & 0 & 0 \end{bmatrix}$$

5. PI gain values of Conventional- Controller for Unilateral Contract case

PI Controller Gain	Contract Violation Case
K_{P1}	0.4301
K_{i1}	-8.0200E-06
K_{P2}	0.1864
K_{i2}	-0.7273

6. Results and Discussion

From the below Contract Violation Frequency and deviation in tie line response, it is quite evident that PI controller removes the offset (steady state error) in frequency and tie-line power of Two area Hydro Thermal system.

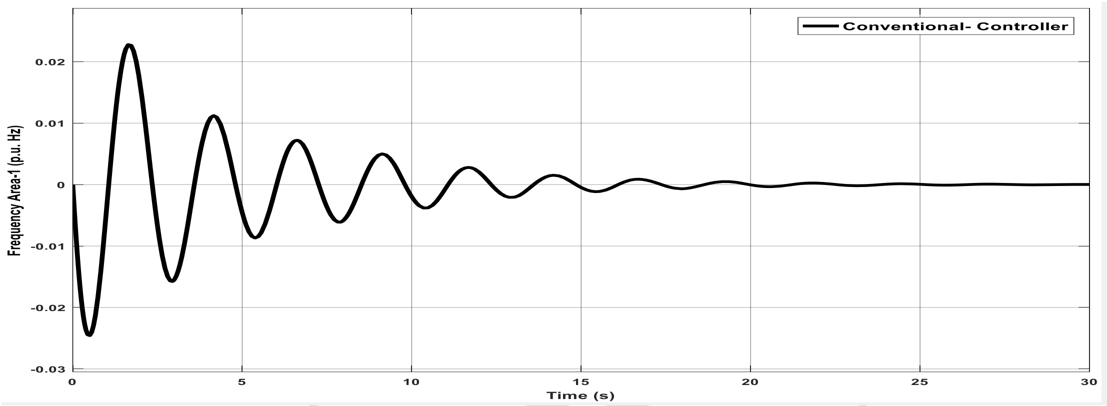

Fig.2 : Response of Contract Violation case of Hydro Thermal system for Area-1 tuned with Conventional-Controller

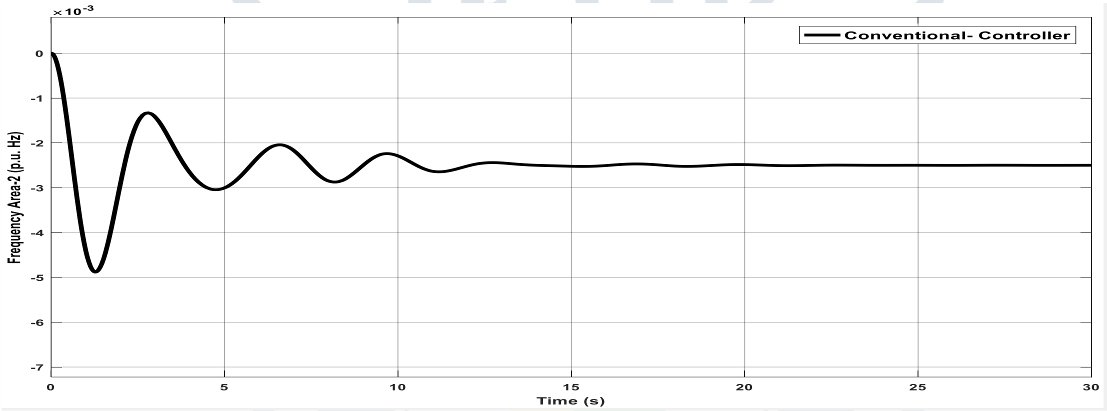

Fig.3 : Response of Contract Violation case of Hydro Thermal system for Area-2 tuned with Conventional-Controller

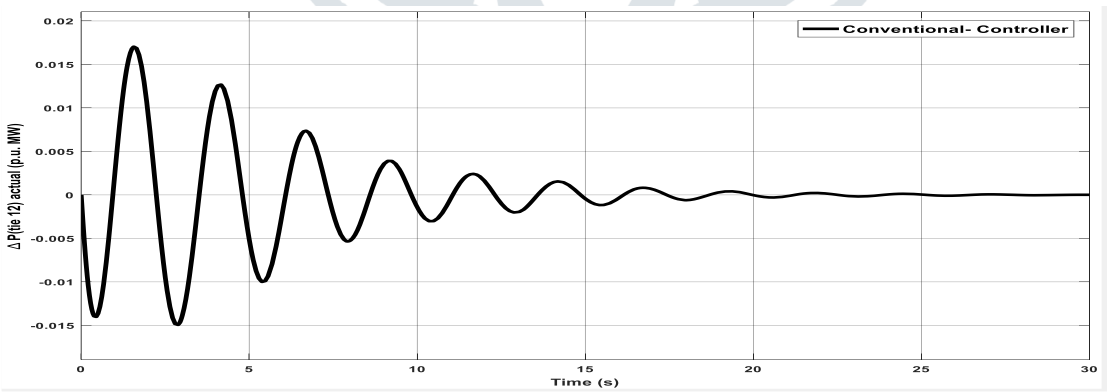

Fig.4 : Response of Contract Violation case of Hydro Thermal system for deviation in tie –line power tuned with Conventional-Controller

7. Conclusion

In this paper, secondary PI controller was developed for Contract Violation case for two area Thermal Hydro scheme. The PI controller is adjusted using Conventional ZN method. All the PI controllers remove the offset in respective area frequencies and tie-line power, when the Hydro Thermal scheme is endangered to unit step load trouble of 0.01 p.u.

REFERENCES

1 Karush, W.,(1939), "Minima of functions of several variables with inequalities as side conditions", MS Thesis, Department of Mathematics, University of Chicago, Chicago, IL.

2 Courant, R., (1943), "Variational methods for the solution of problems of equilibrium and vibrations, Bulletin of Applied Mathematics Society", 49, pp.1-23.

3 Kuhn, H.W. , and Tucker, A.W., (1951), "Non-Linear Programming, Journal Neyman(Ed) Proceedings of the second Berkeley Symposium on Mathematical Statistics and Probability", University of California Press, Berkeley, CA, pp.481-493.

4 Baldwin C. J., Dale K.M., Dittrich R.F.,(1959), “A Study of Economic Shutdown of Generating Units in Daily Dispatch”, AIEE Transaction of Power Apparatus and Systems, PAS-78, pp. 1272-1284.

5 Schmit, L. A.,(1960), "Structural Design by Systematic Synthesis", Proceedings, 2nd Conference on Electronic Computation, ASCE, New York, pp. 105–122.

6 Johnson, Ray C, (1961), "Optimum Design of Mechanical Elements", (first edition), J. Wiley and Sons, New York and London.

7 Wilde, D. J., (1964), "Optimum Seeking Methods", Prentice-Hall, Inc., Englewood Cliffs, New Jersey.

8 Kerr, R. H. , Scheidt, J. L. , Fontana, A. J. and Wiley, J. K., (1966),“Unit Commitment”, IEEE Transactions on Power Apparatus And Systems, PAS-85(5), pp. 417-421.

9 Lowery, P. G., (1966), “Generating Unit Commitment by Dynamic Programming”, IEEE Transactions on Power Apparatus and Systems, PAS-85(5), pp. 422-426.

10 Hara, K., Kimura, M., and Honda, N. , (1966), "A Method for Planning Economic Unit Commitment and Maintenance of Thermal Power Systems", IEEE Transaction on Power Apparatus And Systems, vol. PAS-85(5) , pp. 421-436.

11 Davidson, P.M., Kohbrman, F.J., Master, G.L., Schafer, G.R., Evans, J.R., Lovewell, K.M., Payne, T.B., (1967), “Unit Commitment Start Stop Scheduling in the Pennsylvania-New Jersey-Maryland Interconnection”, 1967 PICA Conference Proceeding IEEE, pp. 127-132.

12 Happ, H.H, (1971), “The inter-area matrix: a tie flow model for power pools”, IEEE Transactions on Power Systems, 90(4) , pp. 36-45.

13 Guy, J. D., (1971), “Security Constrained Unit Commitment”, IEEE Transactions on Power Apparatus and Systems, 90, pp. 1385-1389.

14 Geoffrion, A.M. , Dyer J.S. , and Feinberg, A.,(1972), "An Interactive approach for multi-criterion optimization with an application to the operation on an academic department", Management Science, 19(4), pp.357-368.

15 Vemuri, V, (1974), "Multiple objective optimization in water resource systems", Water Resources Research, 10(1), pp.44-48.

16 Haimes, Y.Y., and Hall, W.A., (1974), "Multi-Objectives in water resource systems analysis: the surrogate worth trade-off method", Water Resources Research, 10(4), pp.615-624.

17 Burns R. M. and Gibson C.A., (1975), "Optimization of Priority Lists for a Unit Commitment Program," Proceedings IEEE PES 1975 Summer Meeting, Paper A75 453-1/1-7, San Francisco, CA.

18 Cohon, J.L., and Marks, D.H., (1975), "A Review and evaluation of multi-objective programming techniques", Water Resources Research, 11(2), pp.208-220.

19 Pang C. K. and Chen H. C., (1976), "Optimal Short-term Thermal Unit Commitment", IEEE Transactions on Power Apparatus and Systems, PAS-45(4), pp 1336-1342.

20 Keeney, R.L., and Raiffa, H., (1976), "Decisions with multiple objectives, Preferences and Value Trade-Offs", Wiley, New York.

21 Zionts, S., and Wallenius, J., (1976), "An Interactive programming method for solving the multiple criteria problems", Management Science, 22, pp.652-663.

22 Dillon, T. S. , Edwin, K. W., Kochs, H. D. and Taud, R. J. ,(1978), "Integer Programming Approach to the Problem of Optimal Unit Commitment with Probabilistic Reserve Determination," IEEE Transactions on Power Apparatus and Systems, 97(6), pp. 2154-2166.

23 Shoults R. R., Chang S. K., Helmick S. and Grady W. M., (1980), "A Practical Approach to Unit Commitment, Economic Dispatch and Savings Allocation For Multi-area Pool Operation with Import/Export Constraints," IEEE Transactions on Power Apparatus and Systems, PAS-99(2), pp. 625 – 635.

24 Zionts, S. and Wallenius, J.(1980), " An Interactive multiple objective linear programming method for a class of underlying nonlinear utility function, School of Management, State University New York at Buffalo, Paper No. 437.

25 Pang C. K., Sheble, G. B., and Albuyeh F., (1981), "Evaluation of Dynamic Programming Based Method and Multiple Area Representation for Thermal Unit Commitments", IEEE Transactions on Power Apparatus and Systems, PAS-100(3), pp. 1212-1218.

26 Brayton, R. K., Hachtel, G. D., and Sangiovanni-Vincentelli , A. L., (1981), "A survey of optimization techniques for integrated-circuit design", Proceedings of the IEEE , 69(10), pp.1334-1361.

27 Vira, C. , Yacov, H. and David, G., (1981), "A multiobjective dynamic programming method for capacity expansion", IEEE Trans. Automat. Contr., 26, pp. 1195-1207.

28 Francisco J. Solis and Roger J-B. Wets, (1981), "Minimization by Random Search Techniques", Mathematics of Operations Research, 6(1), pp. 19-30.

29 Lauer, G. S., Sandell, N. R. , Bertsekas, Jr., and Posbergh, T.A. ,(1982), "Solution Of Large Scale Optimal Unit Commitment Problem". IEEE Transactions on Power Apparatus and Systems, 101, pp. 79-96.

30 Cohen, A. I., and Yoshimura, M., (1983), "A Branch-and-Bound Algorithm for Unit Commitment," IEEE Transactions on Power Apparatus and Systems, 102(2), pp. 444-451.

31 Merlin, A. and Sandrin, P., (1983), “A New Method for Unit Commitment at Electricite De France", IEEE Transactions on Power Apparatus and Systems, 102(5) , pp. 1218 - 1225.

32 Rarig, H.M., and Haimes, Y.Y.,(1983) “Risk/Dispersion Index Method”, IEEE Transactions on Systems, Man and Cybernetics, 13(3), pp.317-328.

33 Reklaitis, G.V., Ravindran, A. and Ragsdell, K.M.,(1983) , "Engineering Optimization: Methods and Applications", John Wiley and Sons Inc., New York.

34 Steuer, R.E., Choo, E.-U.,(1983), "An interactive weighted Tchebycheff procedure for multiple objective programming", Math Program, 26, 326–344.

35 Bosch, V. D. , and Honderd G., (1985), "A Solution of the Unit Commitment Problem via Decomposition and Dynamic Programming", IEEE Transactions on Power Apparatus and Systems”, PAS-104(7), pp. 1684-1690.

36 Lee, K.D., Vierra, R.H., Nagel, G.D., and Jenkins, R.T.,(1985), "Problems Associated With Unit Commitment In Uncertainty”, IEEE Transactions on Power Apparatus and Systems, 104(8), pp.2072-2078.

37 Kusic,G. L. ,and Putnam, H. A. ,(1985), “Dispatch And Unit Commitment Including Commonly Owned Units”, IEEE Transactions on Power Apparatus and Systems, 104, pp.2408-2412.