



Indian Institute of Technology  
Bombay

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# **EE 722 Assignment 2**

## **Available Transfer Capacity (ATC) and Flow Based Market Computing (FBMC)**

GROUP 5

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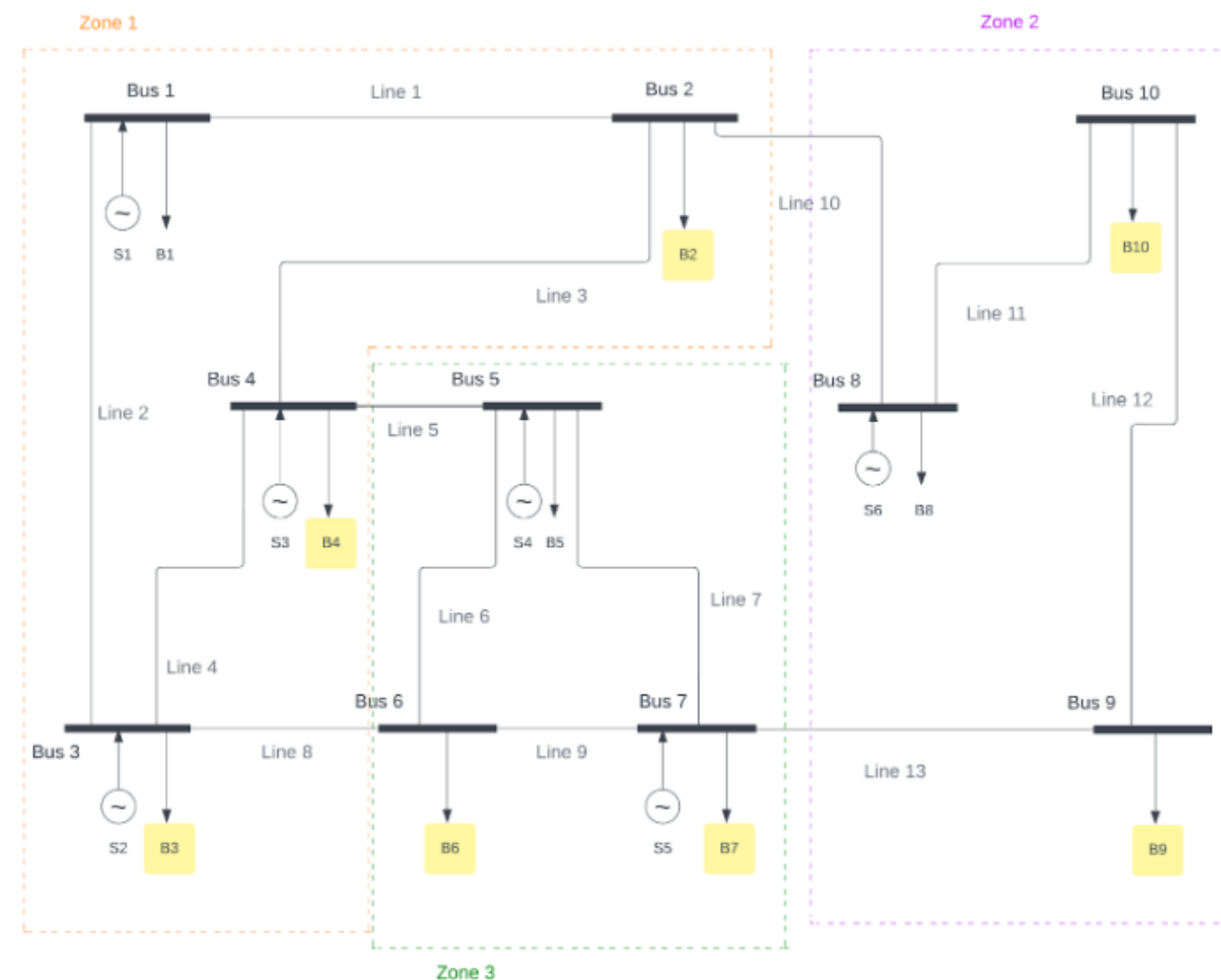
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# Problem Statement

- We have set up a system of 6 generators, 10 nodes, 3 zones and 13 lines to analyze the difference between ATC and FBMC methods under different loading conditions, constraint conditions, and different generator cost conditions. Cost function for each generator is taken to be quadratic.
- Results for both the versions of problem statement is explained





# ATC Method

- We assume that we are given ATC values from the system operator of the inter-zonal lines.
- As we don't know the system details, impedances of all lines was assumed to be the same.  
Multiplying PTDF with ATC gives the  $\Delta f$  (additional flows on the base case), adding  $\Delta f$  to  $f_o$  we get limits on flows of inter-zonal lines.

- Load values of 50,200,280MW were taken. After 280 MW (apprx) the power flow was not converging.
- We observed different prices at each node.

Bus Data								
Bus #	Voltage		Generation		Load		Lambda (\$/MVA-hr)	
	Mag (pu)	Ang (deg)	P (MW)	Q (MVar)	P (MW)	Q (MVar)	P	Q
1	0.900	0.000*	422.86	-68.44	-	-	5.191	-
2	0.964	-7.198	-	-	200.00	0.00	5.371	0.004
3	0.900	-9.583	0.75	-71.12	200.00	0.00	4.999	-
4	0.900	-8.963	135.73	-378.05	200.00	0.00	5.314	-
5	1.079	-7.837	215.89	899.96	-	-	5.527	0.003
6	0.959	-11.500	-	-	200.00	0.00	5.738	0.003
7	0.900	-10.152	302.64	-456.91	200.00	0.00	5.516	-
8	1.100	-5.404	322.13	422.41	-	-	4.889	-
9	0.960	-15.335	-	-	200.00	0.00	5.280	0.004
10	1.025	-13.171	-	-	200.00	0.00	5.073	0.019
Total:			1400.00	347.85	1400.00	0.00		

Fig: Load 200 MW

Load(MW)	Max Zone 1 (\$)	Max Zone 2 (\$)	Max Zone 3 (\$)	Cost
50	4.063	4.063	4.063	1.3403e+03
200	5.371	5.738	5.280	6.2760e+03
280	5.921	7.834	6.193	9.6667e+03



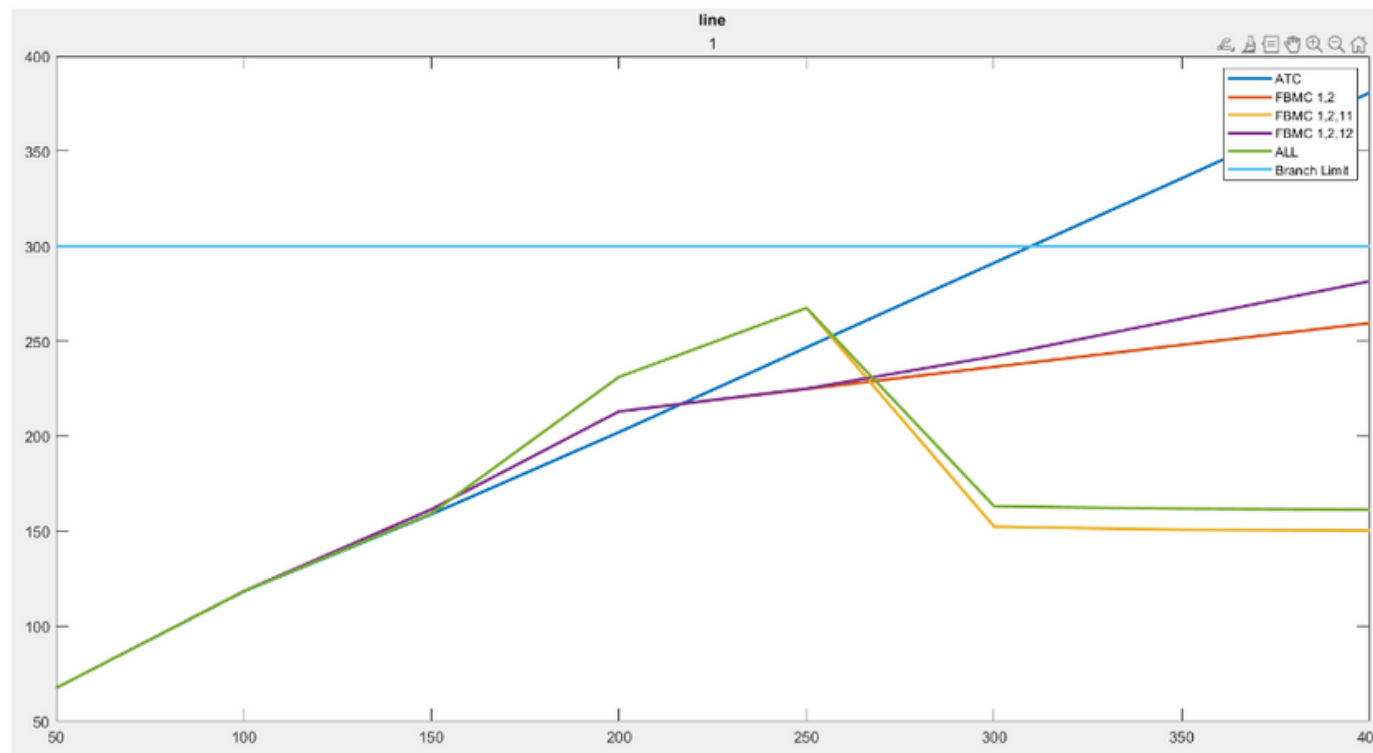
# FBMC Method

**Case1:** Load at buses were taken to be same values

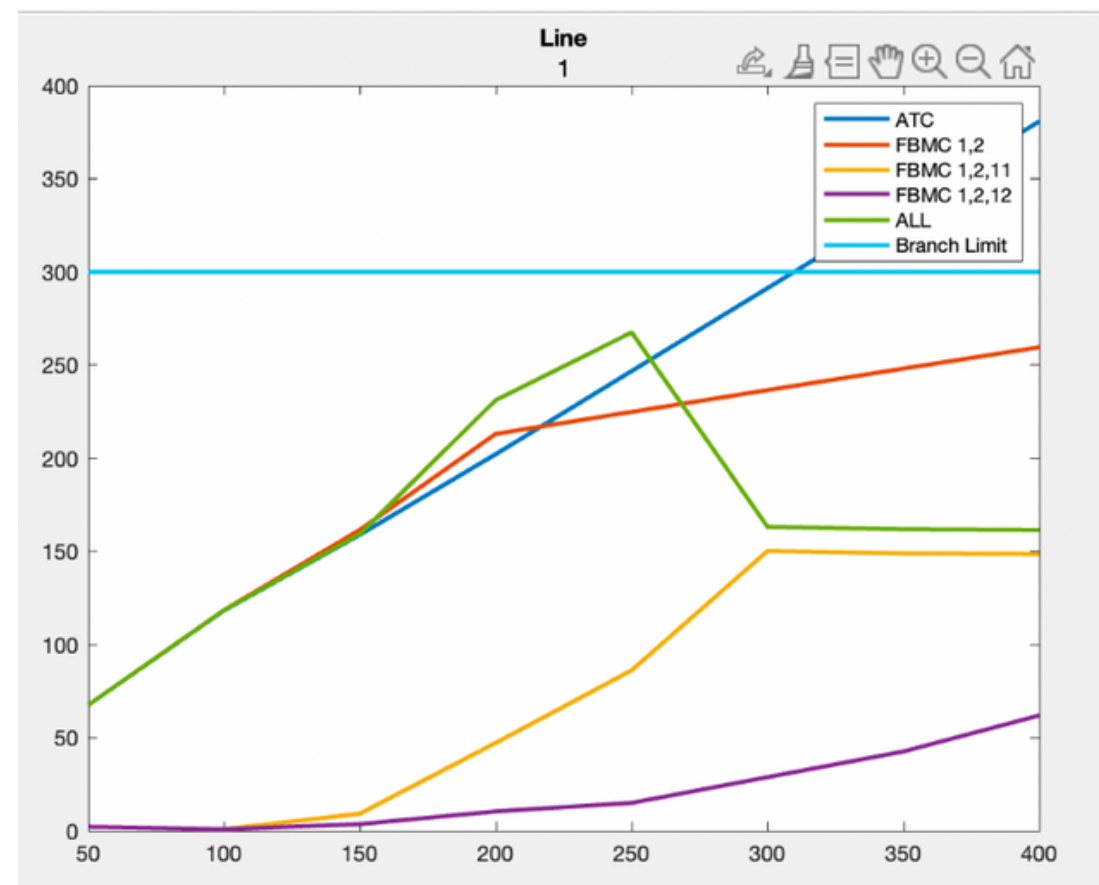
**Case2:** Quadratic cost coefficient of generator 1 was multiplied by 5 so hence we can see priority and hence the flow shifts to other generators(precisely near gen 5)

**Case3:** Increased the flow limit for those lines which were getting clipped at even low loads like 150 MW.

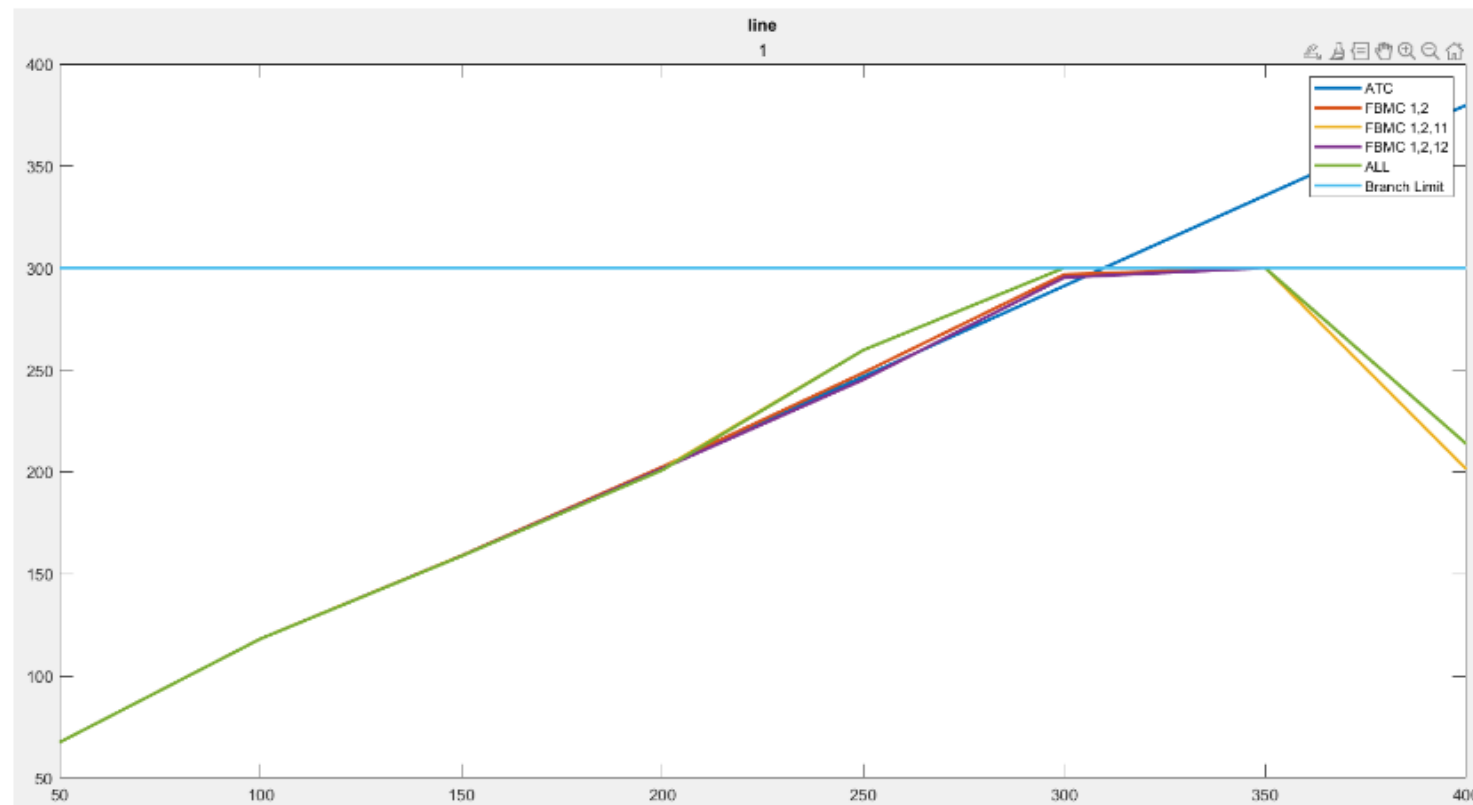
**Case4:** Load at buses were taken different values



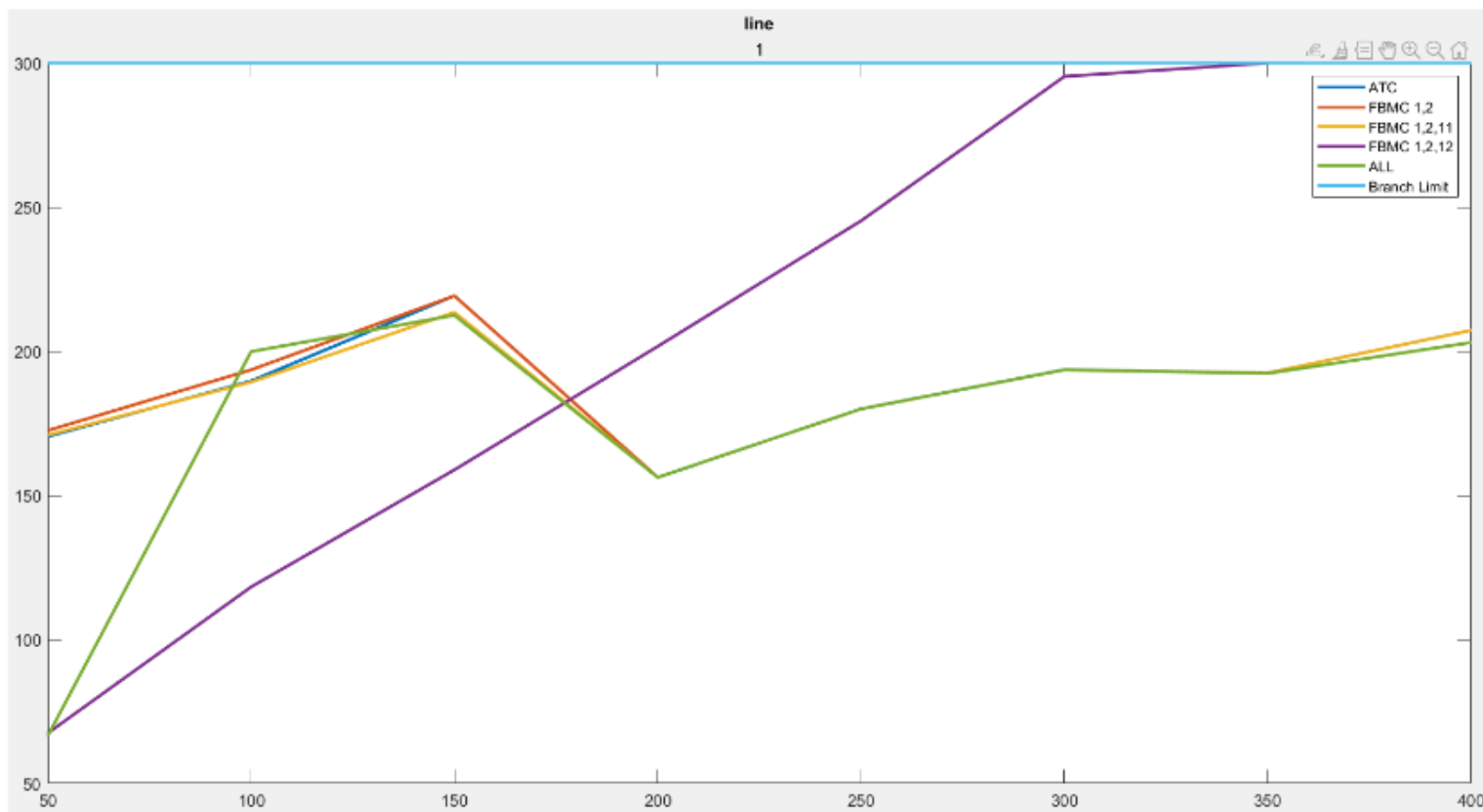
As we can see line 1 is overloaded in ATC as it is the nearest to least cost generator. In FBMC 1,2 meaning apart from inter-zonal branches lines 1,2 (red line) were constrained it is below the light blue line (branch limit of line 1), similarly for FBMC 1,2,11 and ,FBMC 1,2,12



As compared to case 1 the flow decreased on line 1 as it is more costly to pump power on this line (quadratic cost coefficient is 5 times more.



We can see the point where it gets clipped shift towards right as compared to case 1



Different load values at different nodes were taken to implement a practical system