

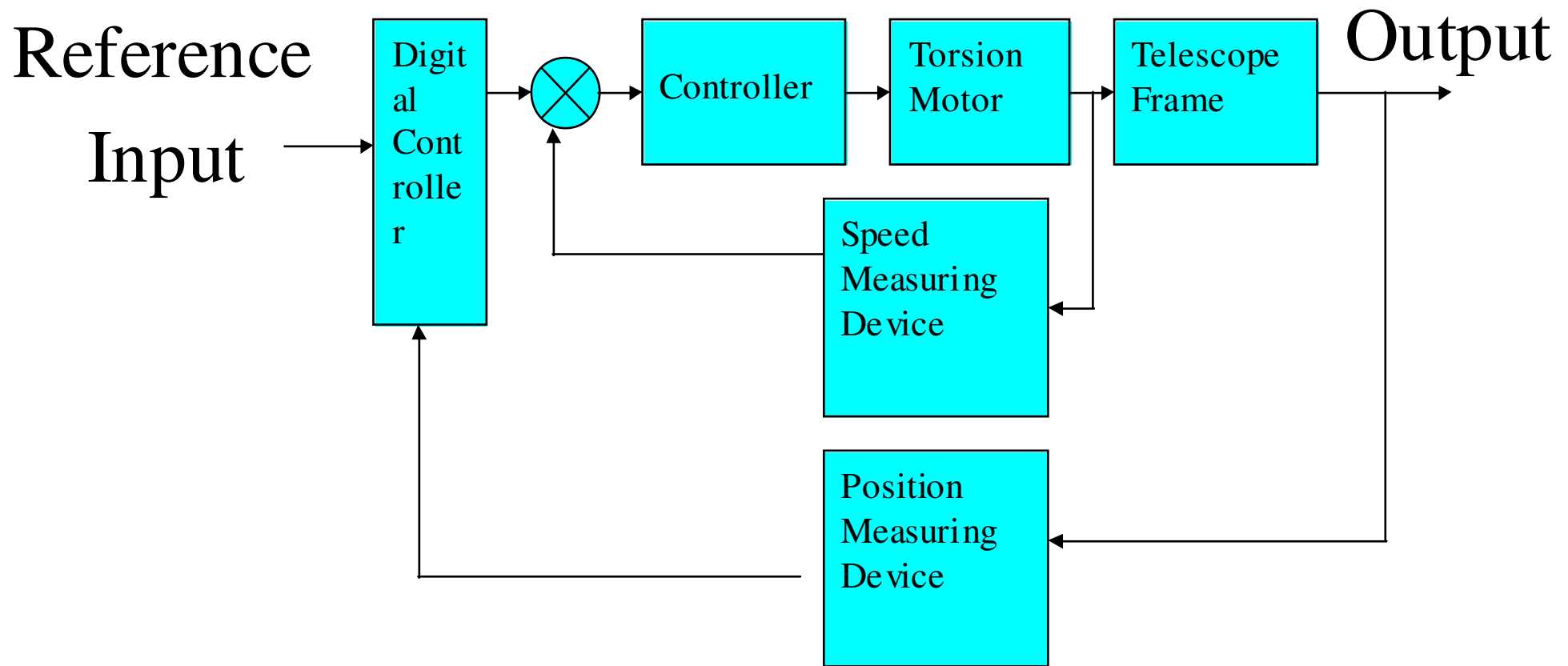
Study on Servo-Control System of SLR/LLR Telescopes

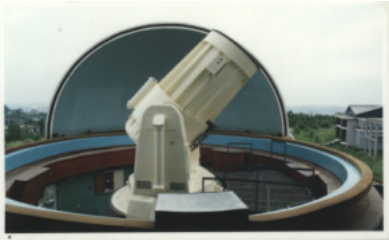
Li zhulian, Zheng xiangming, Xiong yaoheng

Yunnan Observatory of
Chinese Academy of
Sciences, Kunming, China



Modern Telescopes Servo-Control Systems





Compensation Network

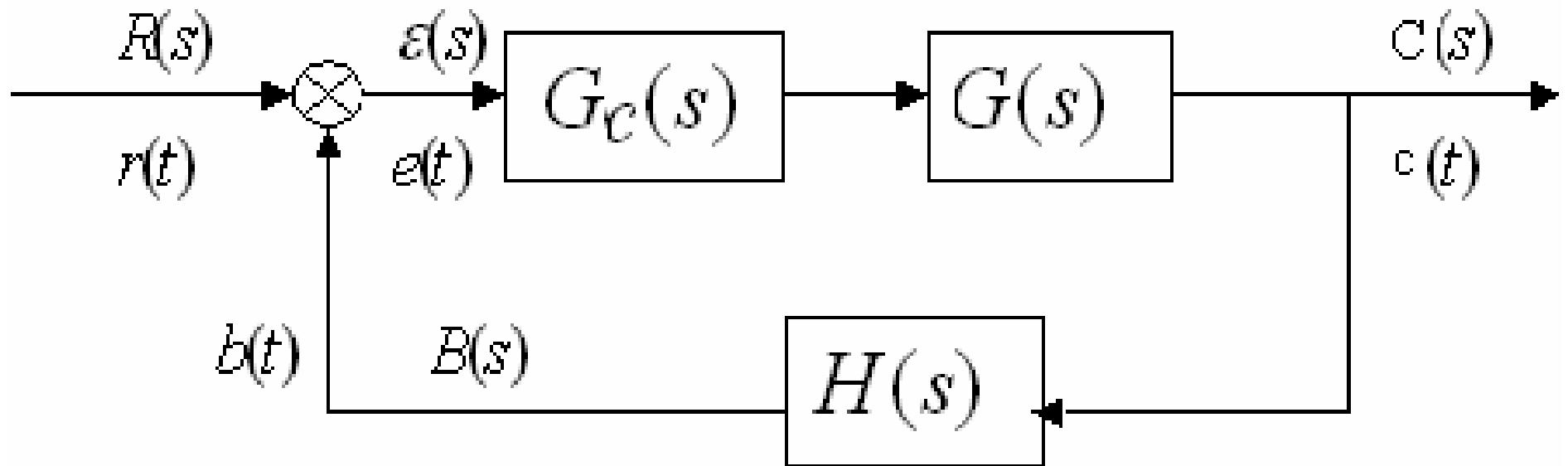
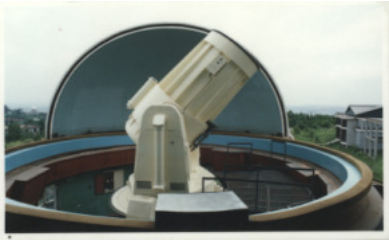


Fig: Feedback Control Loop with Compensation



Compensation Network

compensation

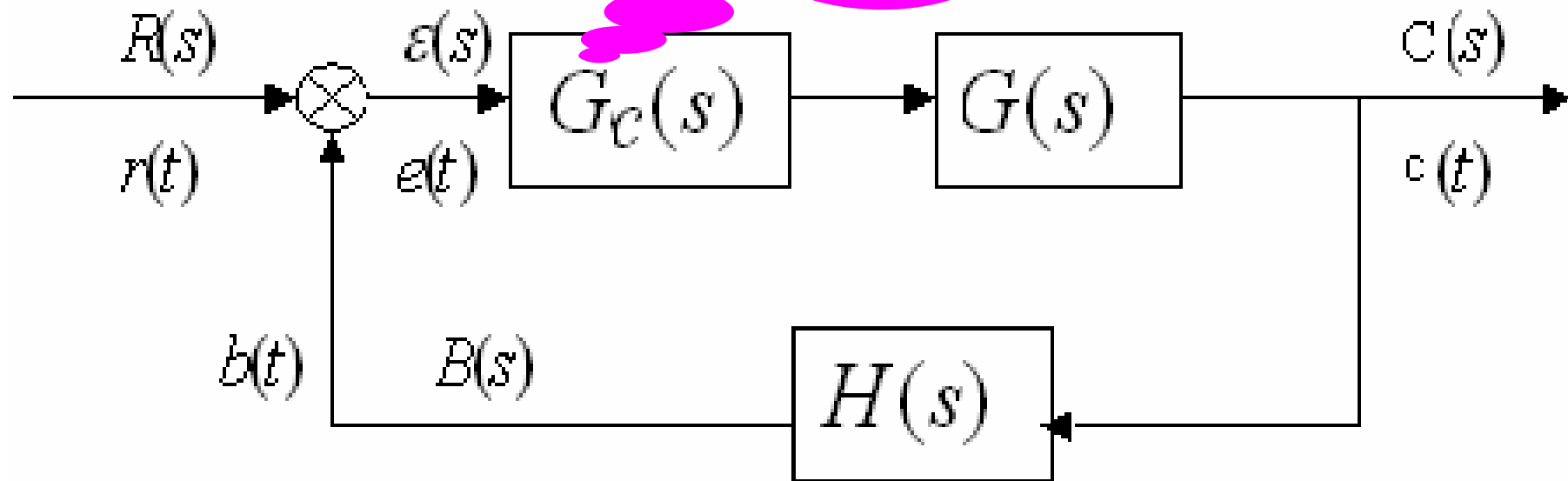
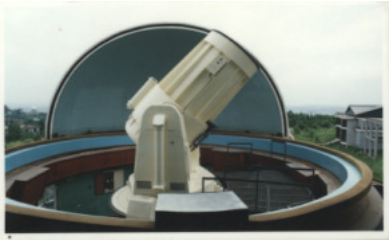


Fig: Feedback Control Loop with Compensation

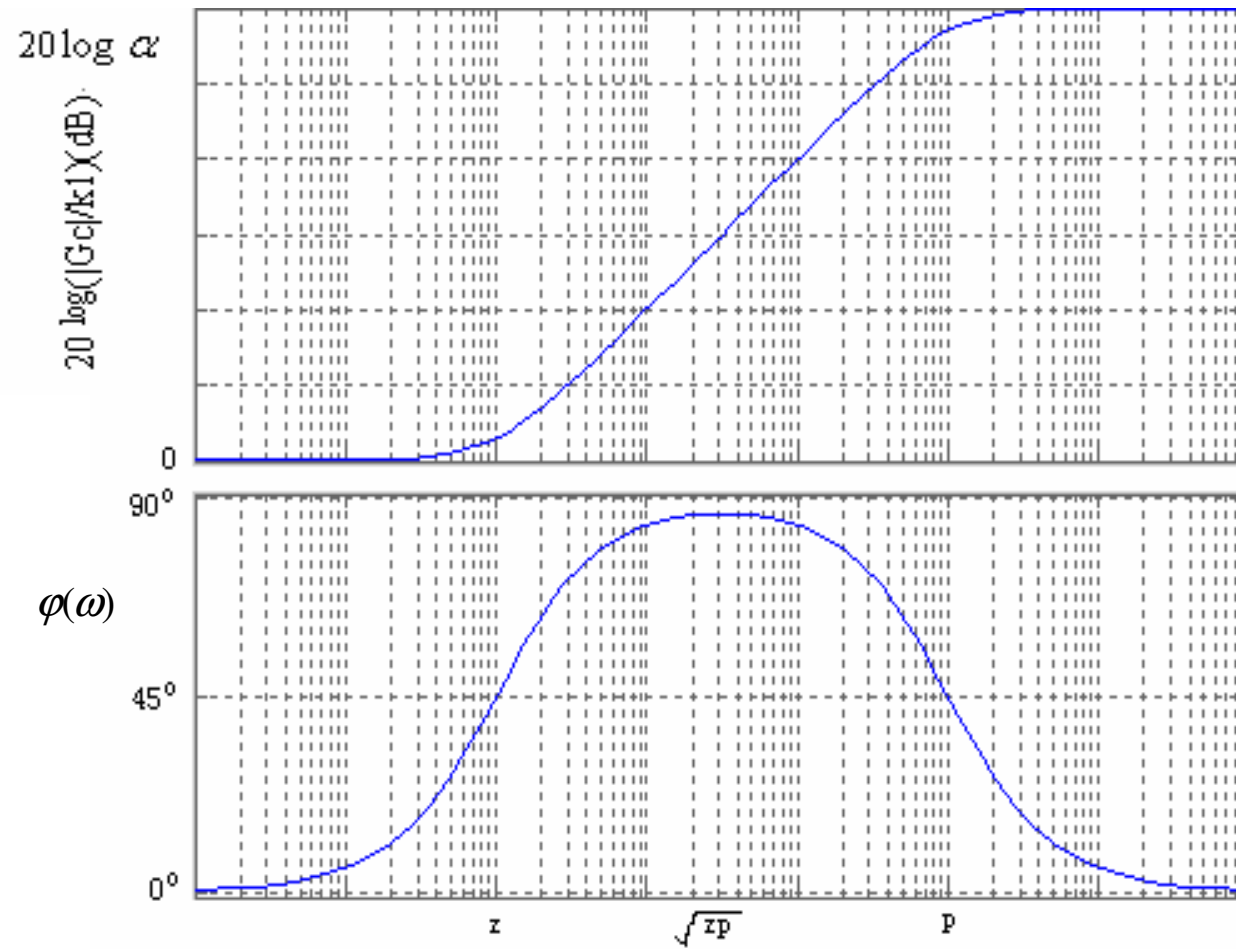


Compensation Network

- **PD**(**P**roportion **D**ifferential) Compensation Network
>> Characters
- **PI**(**P**roportion **I**ntegral) Compensation Network
>> Characters
- **PID**(**P**roportion **I**ntegral **D**ifferential) Compensation Network
>> Characters

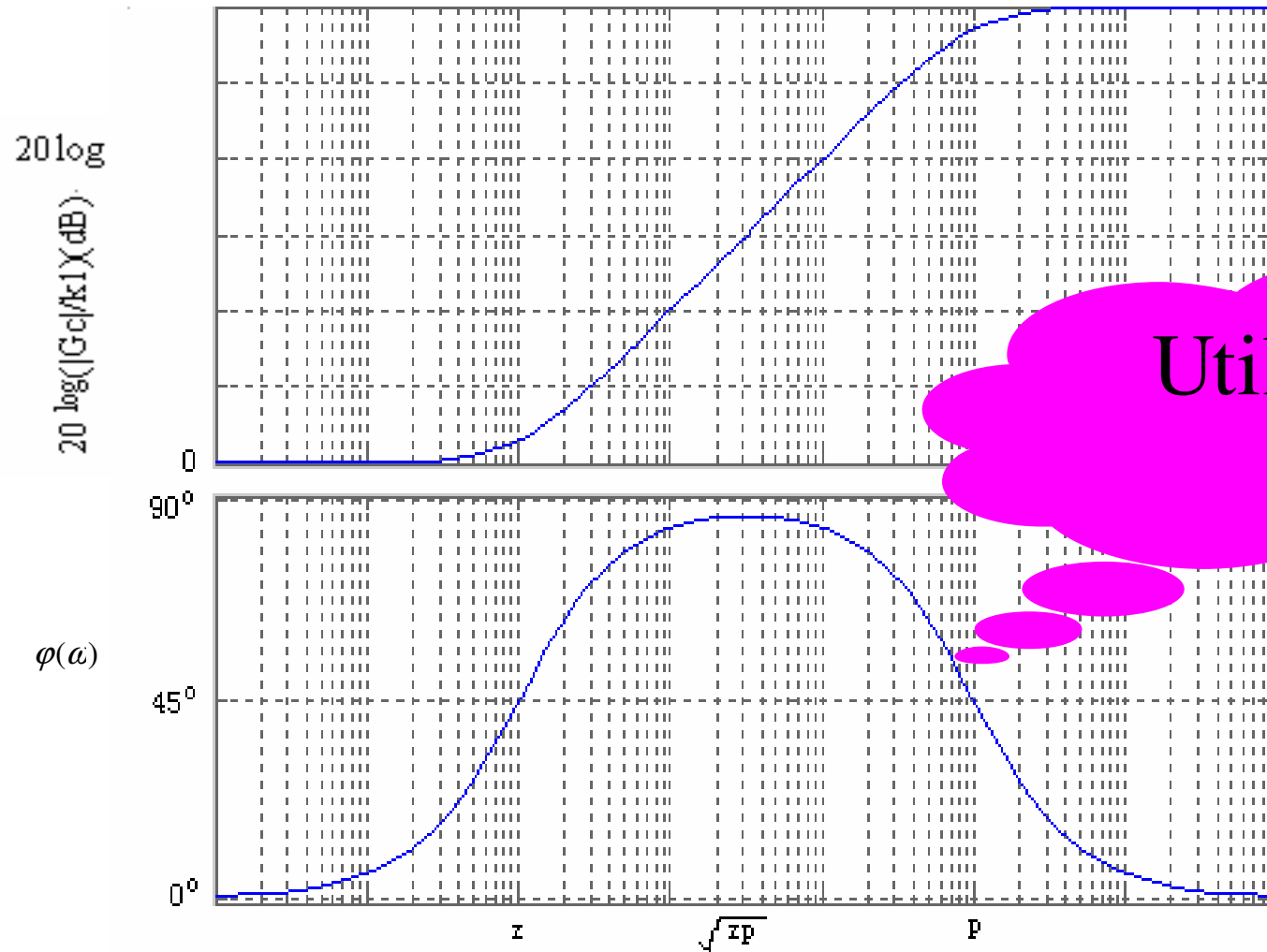


The Bode Graph of PD Compensation





The Bode Graph of PD Compensation

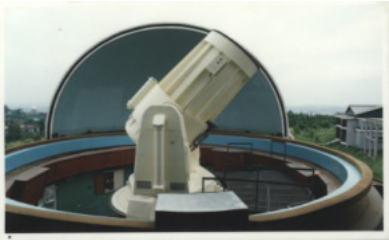


Utilized Part

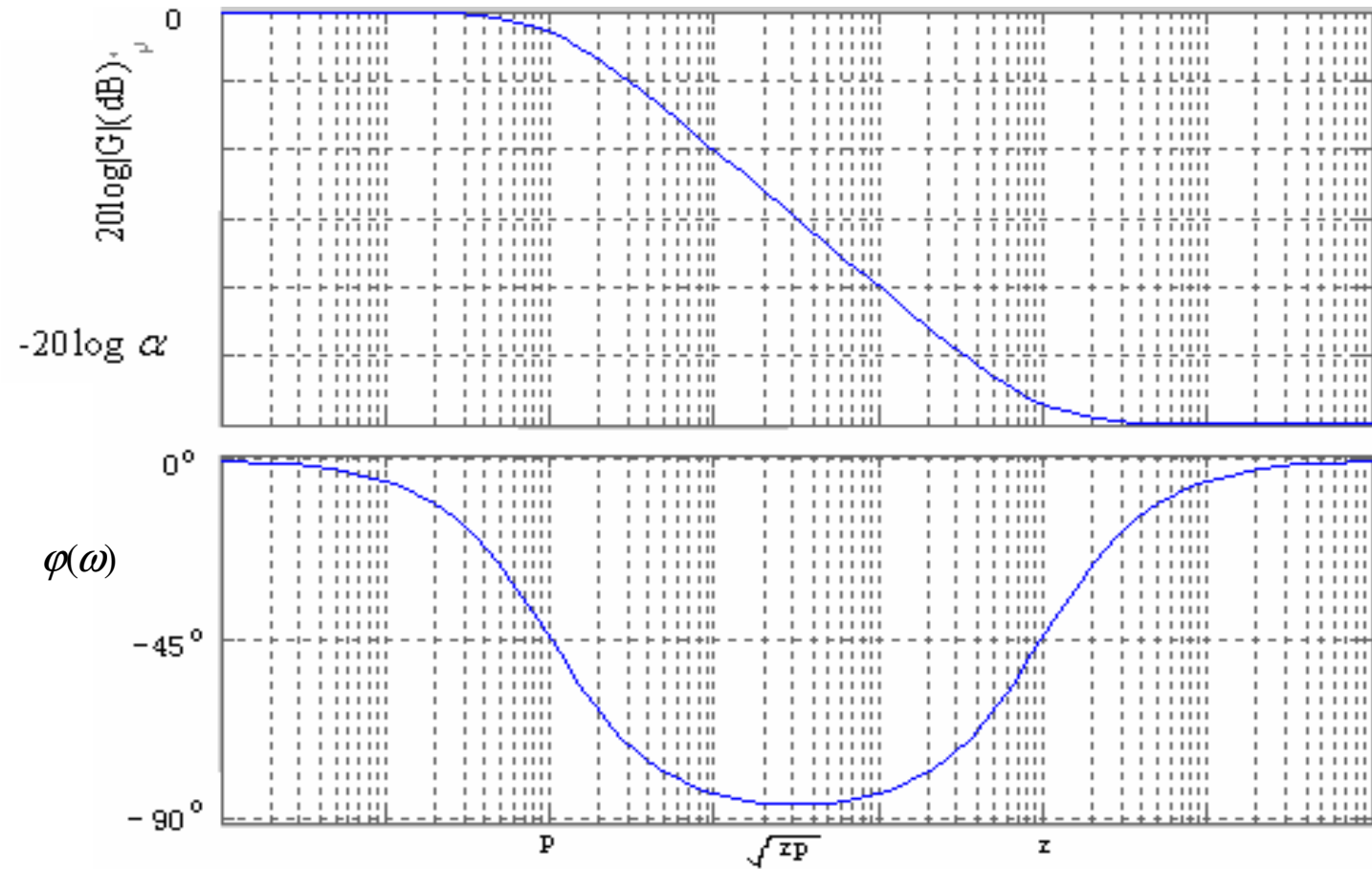


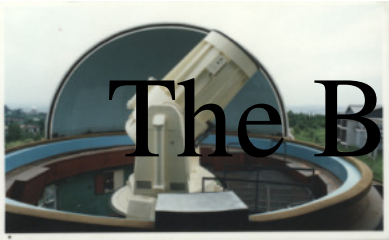
PD Network Characters

- Make system response more quickly
 - >>to enable telescope to track some quick bodies, such as, satellites near the earth
- Improve system dynamic capability
 - >>able to get expected response
- Stability accuracy hardly changes
- Increase high frequency noise effect
 - ➔ usable when require quick response

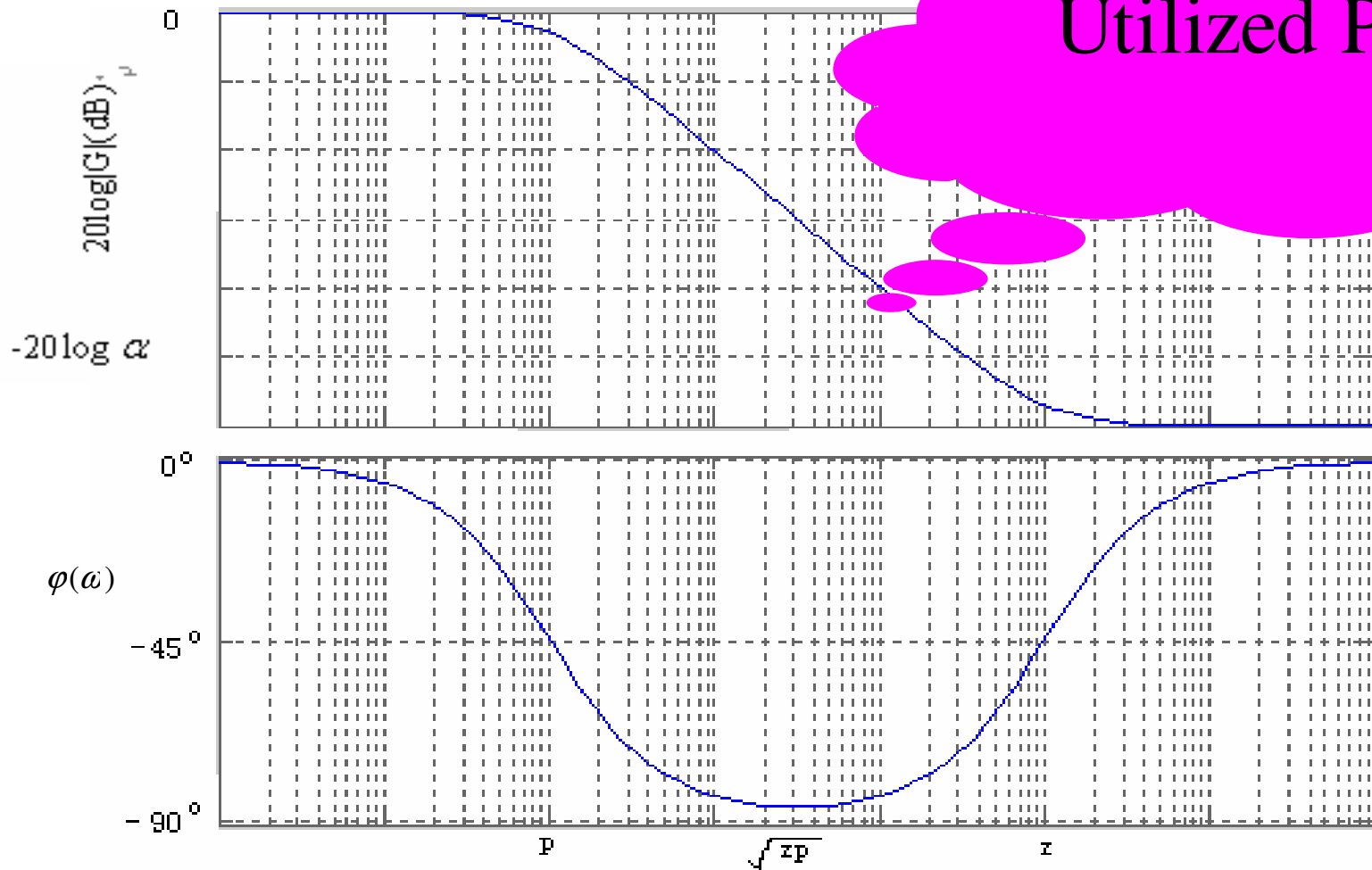


The Bode Graph of PI Compensation

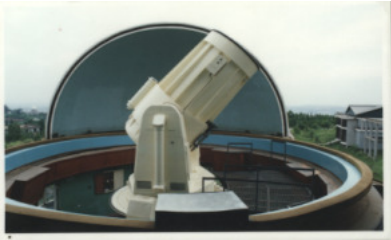




The Bode Graph of PI Compensation



Utilized Part



PI Network Characters

- Improve stability accuracy

>>able to decrease system stability error!

- Decrease high frequency noise effect

- Long instantaneous response time

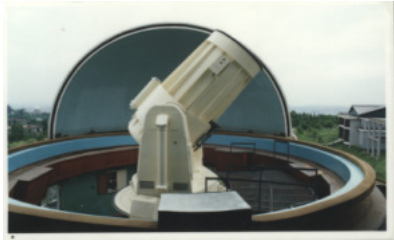
>>unfit for the telescope expected to track quick bodies

➡ usable for expected high stability precision



PID Network

- “PID = PI + PD”
- PID has both PI and PD’s advantages
- Need more devices and more design cost



1.2m alt-az telescope servo-control system

PI Network

Maximum speed:

altitude... 1° /s ;

azimuth... 1° /s

Accuracy :

altitude ... 0.3° /s

azimuth ... 0.3° /s

PD Network

Maximum speed:

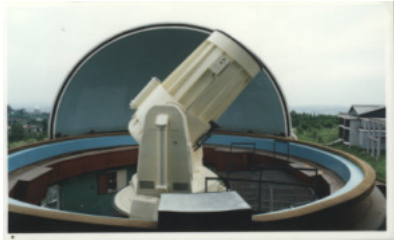
altitude... 3° /s ;

azimuth... 5° /s

Accuracy :

altitude... 3° /s

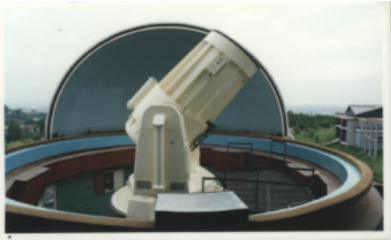
azimuth ... 1.5° /s



1.2m alt-az telescope servo-control system

- Able to fulfil $\geq 400\text{km}$ slr at present
- Pointing accuracy expected to improve

>>we use software method to solve this problem, such as ,“small period model”



Conclusion

- PD compensation method + software

adjustment  useful for the telescopes

ranging from low to high orbit bodies

Thank you!

