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Space Launch Reliability History

Tymon Sharp, Bastion Technologies Intern, BS Physics UAH, MS 2020

Frank Hark, Bastion Technologies, QD35, Marshall Space Flight Center

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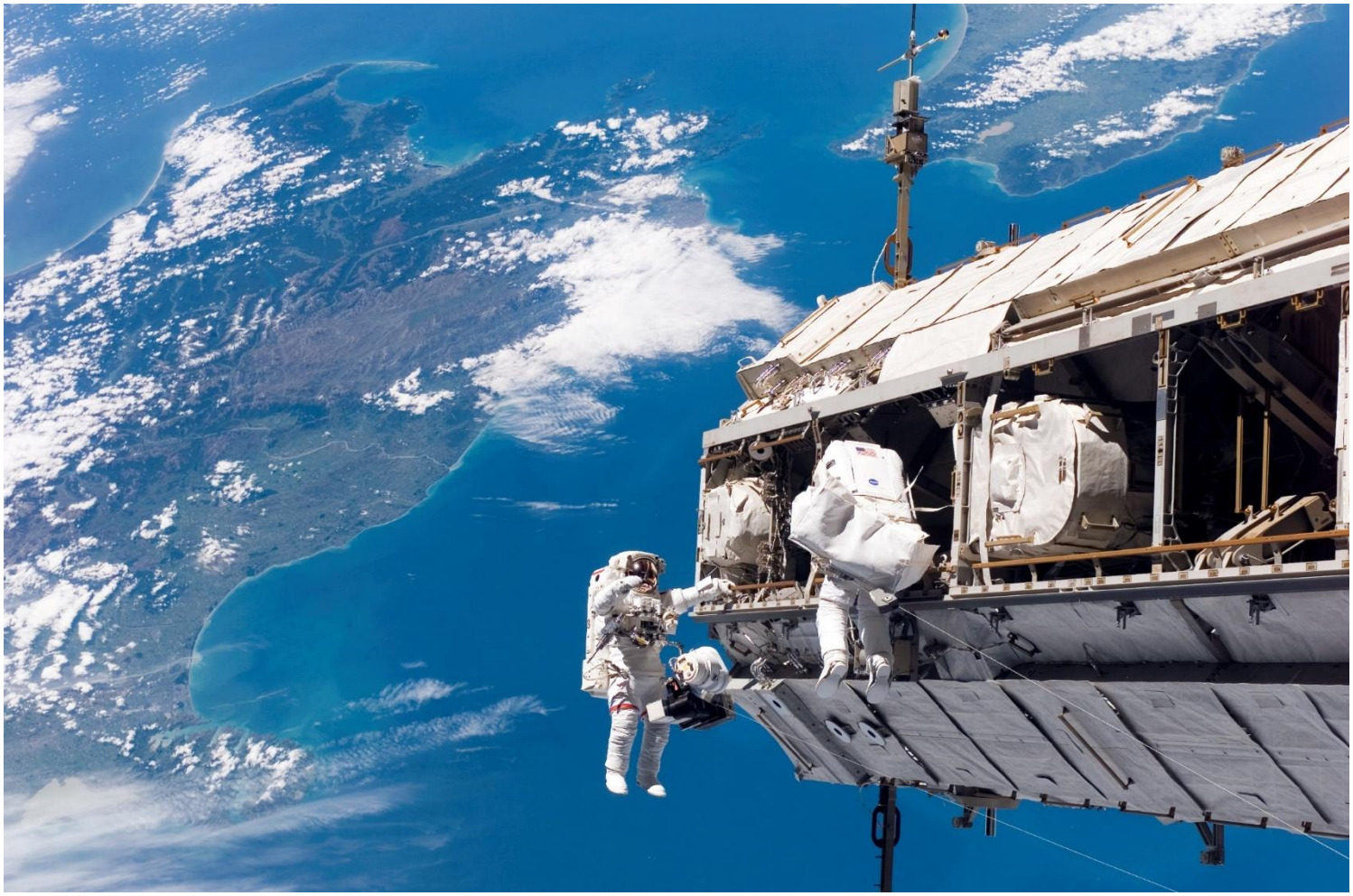
- A little bit of history



History

- Robert H. Goddard
  - Inspired Wernher Von Braun
- The V-2 rocket (1942)
- R-7 (1957)
- The Space Race
  - 1957
  - Sputnik 1 and Explorer 1
  - Apollo 11

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Past





Past

- Learning
  - Mostly accidents such as: fires, new technology, vacuum of space, space suits, rocket failures
- Russia and USA

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Present



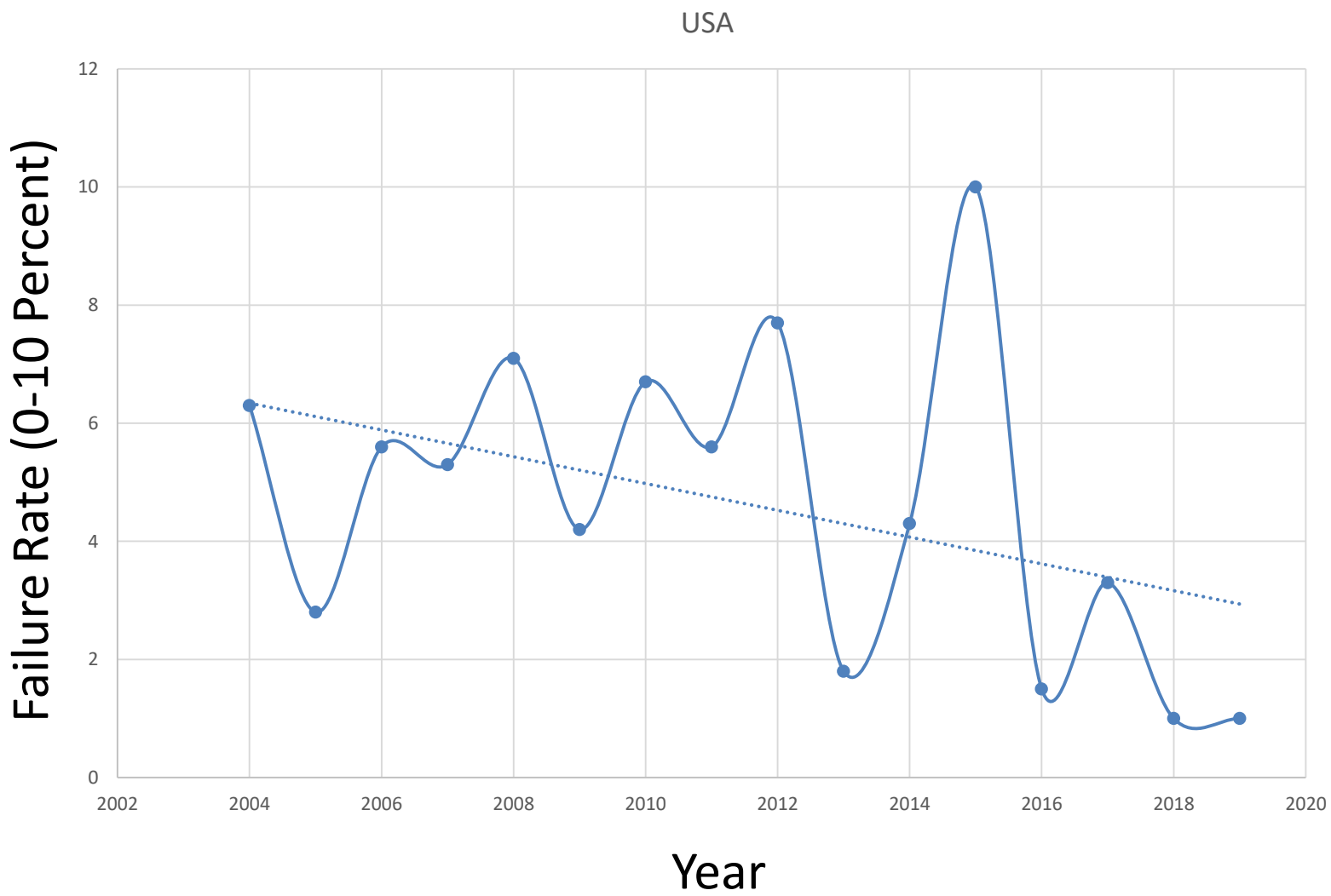


Present

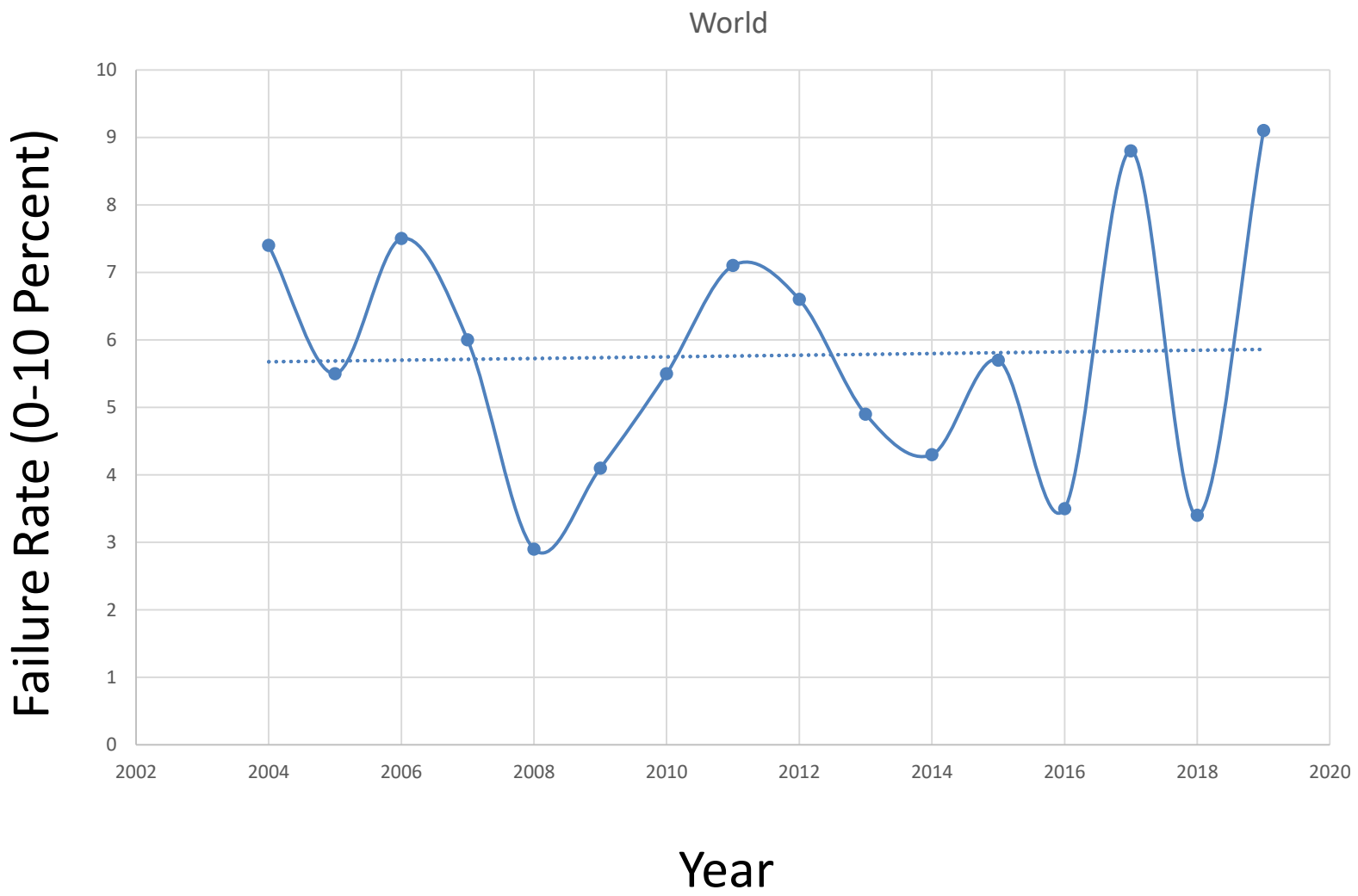
- Space flight is becoming increasingly popular
  - The first 8 months of 2019 had more launches than 2004 had in a year
- Worldwide safety has remained constant
  - Iran and China
  - USA at <1% failure rate since 2017
- 2018 was the busiest in history and 2019 is set up to take the lead

All data is open source

Present


USA
Failure Rate (0-10 Percent)
12
10
8
6
4
2
0
2002
2004
2006
2008
2010
2012
2014
2016
2018
2020
Year

Present


World
Failure Rate (0-10 Percent)
10
9
8
7
6
5
4
3
2
1
0
2002
2004
2006
2008
2010
2012
2014
2016
2018
2020
Year

Present

- As time progresses, things become more controlled
  - Consistent downward trend for most countries
- Facing different troubles in spaceflight
  - Separation and attitude

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Future





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Future

- Downward trend in failures for countries that institute safety and reliability tactics
- 2019 and 2018 both have zero failures thus far and the US is averaging about 1 in 102 failure rate using the 1/3 rule

Future

- Interplanetary travel
  - New and unknown hazards
- New unknown unknowns

Future

- Next challenge in Reliability and Maintainability
  - New environmental hazards
    - Extended periods of time in space
  - Predictability
    - The corona of the sun
    - Parker waves
    - Parker Solar Probe

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Conclusion





Conclusion

- Reliability over the past 6 decades
  - Launch rate is increasing
    - Commercialization and space exploration
  - Reliability has remained relatively constant
    - Recent data indicates possible improvement in reliability
- Reliability in the new era of spaceflight
  - Key to safe spaceflight as we return to unknowns

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QUESTIONS?

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Thank You!

Tymon Sharp, tps0006@uah.edu

Frank Hark, frank.hark@nasa.gov