Flight Dynamics and Trajectory

Jason Smith

Lance Belin - NASA> Aerospace Scholars, let me introduce your next speaker, Jason Smith

<Michael Both> hello

<lili munro> hi

<Jason Smith - NASA> Hello everyone

<David Ring> hello

> Hello to JAson S

<Nathan Hughart> Whats goin on?

<Jason Smith - NASA> I will start by telling just a little about myself and then open it up for questions

<Jason Smith - NASA> I work here at NASA in the Flight Dynamics group. I work in the Mission Control Center for the Space Shuttle that you see on TV

<Jason Smith - NASA> Our console is responsible for the trajectory of the Shuttle. We plan all the burns that get us where we need to go safely.

<Jason Smith - NASA> Before I worked in this group, I worked in a very similar group in the Control Room of the Space Station.

<Jason Smith - NASA> So, I know a little about both vehicles.

<Jason Smith - NASA> I went to school at BYU and MIT. I have a Mechanical Engineering degree from BYU and an Aeronautical/Astronautical degree from MIT.

<Jason Smith - NASA> I grew up in NJ, but I have always loved

space and I am always excited to talk about it.

<Blythe Schultz> I've considered attending MIT. Did you enjoy it

there?

<Jason Smith - NASA> So, with that, I will open it up and let you

guys ask questions.

<Kody Schouten> What did i missed??

<Jason Smith - NASA> Blythe - MIT is excellent. It is a very

challenging environment, so if you go there, be prepared to work. A

lot. But you will learn a lot also, and have access to great resources

in the faculty.

<Blythe Schultz> Were the classes very large?

<Kody Schouten> Do we got the schedule changed?

<Jason Smith - NASA> Blythe - I went there for graduate school, so

by it's nature, graduate school classes are usually pretty small. The

undergraduate classes are bigger, but not too hJason Smith - NASA> Blythe - I went there for graduate school, so

by it's nature, graduate school classes are usually pretty small. The

undergraduate classes are bigger, but not too huge.

<Jason Smith - NASA> Kody - I am sorry, but I don't understand the

question.

<Nathan Hughart> Ah yes, Jason, you handle the awesome squiggly

trajectory lines that go up and down the huge screen. I can guess

that requires a good amount of calc.

<Nathan Hughart> Kody, no its going normal

<Blythe Schultz> Is there a lot to do on and around the campus when

you're not working?

<Nathan Hughart> This is still on schedule

<Kody Schouten> I thought it should be chat for "Exploration System" with Mr. Gruener?

<Nathan Hughart> ?

<Nathan Hughart> thats 5-6 pm

<Nathan Hughart> its 7 CST

<Michael Both> this is the last chat of the day

<Kody Schouten> Really? Mine said its 7-8pm

<Jason Smith - NASA> Kody - yes, sorry, there was a last minute change. Mr. Gruener could not be here at 7, so I switched with him. Sorry.

<Nathan Hughart> ??

<Kody Schouten> Oh I see.... okay!

<lili munro> o

<Nathan Hughart> They must've done a lightning fast edit

<Jason Smith - NASA> Blythe - MIT is right in the middle of Cambridge Mass, a fairly big city right across the river from Boston. The campus is quite urban, but there is a lot to do around Boston. It is a big city, and very cold in the winter, by the way.

<Jason Smith - NASA> Other questions?

<Nathan Hughart> Alrighty, you handle space shuttles, no? Do they just sort of pick you to be on that day's Mission Control, or are you tied to a shuttle or something?

> Did you start right in with the shuttle when you came to NASA?

<Jason Smith - NASA> Nathan - We are assigned particular missions Did you start right in with the shuttle when you came to NASA?

<Jason Smith - NASA> Nathan - We are assigned particular missions

to work by our group lead.

<Nathan Hughart> so it goes by mission....got it

<Jason Smith - NASA> Each mission has 3 shifts, 8 hours each, so

the console is staffed 24/7 when the shuttle is flying.

<Jason Smith - NASA> We are assigned to work one of the 3 shifts

for a particular mission. That way, when we are preparing for the

mission, we get to know the other people on the team pretty well

and can work together better.

<David Ring> what do you need to study for flight dynamics?

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worked in the Space Station control room.

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Space Station. Then, after a couple of years, I moved over to the

Space Shuttle.

> You prefer working w/ shuttle over the ISS?

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an aerospace or aeronautics degree. However, we also have math

and physics majors. The most important thing to understand is

orbital mechanics. And generally most people in Mission Control

have engineering degrees, but that is not a requirement.

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<Jason Smith - NASA> We are responsible for interfacing with US military folks who monitor space junk and let us know if we are getting close to something.

<Sarah Stephen> Has space junk ever caused... a lot of damage to a payload?

<Nathan Hughart> right...i was just about to ask that....was wondering if the station had some sort of radar or sonar going on

<Michael Both> yeah, how much damage could... lets say a pair of binoculars do to the station if its floating adrift in space?

<Jason Smith - NASA> Chris - we are notified several times a week of potentially close encounters with space junk. Most of the time, it turns out not to be a problem. But once in a while, a piece will get close enough that our rules force us to maneuver just to make sure we are out of the way.

<Nathan Hughart> binoculars would probably do some serious pain, considering the required velocity

<Christopher Bouton> Are there any plans to remove any space debris from orbit or is it left to eventually let it burn in the atmosphere?

<Nathan Hughart> if micrometeorites are such an issue....

<David Ring> as more junk accumulates in space, will there be too much to keep away from?

<Jason Smith - NASA> Sarah - there have been several areas on the space station where we have seen evidence of debris strikes. Fortunately, these have all been small pieces and the space station was designed to withstand these types of impacts, so nothing serious has been damaged yet.

<Sarah Stephen> I think I read once in Wired about a machine that

would clean up space junk... I'm sure there's been prototypes.

<Jason Smith - NASA> Michael - now, something say the size of binoculars, if they were to hit the station, would cause some very serious damage. Fortunately, things that size can almost always been seen using military ground tracking resources, so we would know about it beforehand and move out of the way.

<Nathan Hughart> called it

<Michael Both> cool

<Michael Both> yes you did

> I know the media types make a big deal out of the velocity of the "junk" at thousands of km/h....but what is a typical speed of the junk relative to ISS? Guess it depends a lot on the orbital directions of the two vehicles?? approaching or not...?

<Jason Smith - NASA> Christopher - there are no serious plans I know of to remove space debris. There are some recent treaties between countries to try to reduce the amout of junk being created, but no one really knows how to get rid of it. If you have any ideas, let me know. Maybe we could get rich :)

<Nathan Hughart> win

<Christopher Bouton> ok

<Jason Smith - NASA> David - some people get nervous about too much litter in space. Right now, there is a lot of stuff up there, but space is also really, really big. So, it is still OK. But, in another 100 years, who knows. So, we should be careful with the junk we create.

Nathan Hughart> *makes me think of that movie, WALL-E, with that massive cloud of debris surrounding the earth*

<Jason Smith - NASA> Chris - yes, the velocity of the debris is a relative velocity problem. So, it can vary between 34,000 mi/hr, if it were a head-on collision, to 0, if it were moving exactly with us. More typical relative velocities are in between the extremes, say 20-25,000 mi/hr.

> Let's hope it never gets to the point of a huge cloud!

<Nathan Hughart> yeah

<Jason Smith - NASA> Yes, there are a lot of things about WALL-E that I hope we never get too see.

<Nathan Hughart> haha

<Nathan Hughart> agreed

<Christopher Bouton> Are there any large scale ideas for sending people to space instead of on basically a rocket?

> Do most objects placed in orbit move in one particular direction,,,like west to east, roughly, or is there no particular pattern? I mean is it determined mostly by the requirements of the mission?

<Michael Both> Think I saw somthing on 2057, about space elevators

<Christopher Bouton> i also saw that. Something about using carbon nanotubes or something similar

<Nathan Hughart> oh yeah

<Jason Smith - NASA> Christopher - there are tons of ideas out

there. However, practically speaking with technology we have right now, we don't know how to do it on a large scale. Our atmosphere is just so thick that it takes a tremendous amount of energy just to get a relatively small payload to orbit.

<Nathan Hughart> space elevators would be awesome....

<Christopher Bouton> ok

<Nathan Hughart> but not exactly easy to make

> Was it A. C. Clarke who's written so much re: space elevators? Interesting idea...

<Michael Both> The author of the Space Oddessy Series?

<Michael Both> I read somthing about it in his novel 3001

<Nathan Hughart> idk, but we need to come up with some seriously better alloys or metals that are easy to make, that thing will NOT be easy to make

Nathan Hughart> I recall the popular name being a 'space tether' ?

<Jason Smith - NASA> Chris - we like to launch things going west to east. This is because we gain efficiency from the Earth rotation. Since the Earth rotates to the East already, launching east means we have a little less velocity to get into orbit. However, as you point out, depending on mission requirements, we may launch to the west or even over the poles. The space shuttle does not do this. Those launches are all out in California.

<Nathan Hughart> carbon nanotubes are really strong, but even they might not be strong enough to handle their own weight when the line is 120 km long

<Sarah Stephen> I heard that we might use nanomaterials for a 'space

elevator'. and that ppl already hold protoype competionions for them

> Do other countries tend to launch in a particular direction?

<Nathan Hughart> idk, but Jason's west to east sounds like it would be rather universal, save for satellites

<Jason Smith - NASA> Chris - the laws of physics are still true in other countries :) Seriously, most launches like going East to be efficient. Also, launching at the equator is even more efficient, so some companies have experimented with that. However, you also have to consider where the land mass is and where the people are. You generally don't want to launch over populated areas for safety reasons.

> Of course what I'm getting at is... how would the debris end up moving at high velocity toward the ISS or shuttle if it came form a vehicle that was launched w to e?

> that is....in the same general direction as the ISS or shuttle...

<Nathan Hughart> So, in working with trajectory, i can guess your prerequisites probably included a lot of calculus right? hehe....I could've sworn the germans would've found a way around pesky physics by now :)

<Jason Smith - NASA> Chris - that is a pretty complicated question, even though it doesn't seem like it. The easiest answer is, think about it in terms of intersections. Most of the debris is coming from the sides, because even though most launches are east, the launches occur at different times. So, the objects are not all in the same orbital plane. Two objects in different planes could potentially get close to each other and intersect at 90 degrees, even though they were launched in the same direction. That is probably not a very good answer. Sorry :(

<Nathan Hughart> well i got the idea

<Nathan Hughart> the earth wobbles

<Nathan Hughart> its spins on an axis

<Nathan Hughart> not all the trajactory lines will be parallel

<Jason Smith - NASA> Nathan - yes there is a heavy math component to the work we do, including calculus. Fortunately, we have computers to do most of the heavy lifting for us.

<Nathan Hughart> win!

<Michael Both> ▲ win

<Nathan Hughart> ♠

<Jason Smith - NASA> Just a few minutes left. Any more questions?

<Nathan Hughart> once again...I'm good :)

<Jason Smith - NASA> Buehler?

<Michael Both> lol

<Michael Both> nice

<Nathan Hughart> buehler?

<Nathan Hughart> lost me....

<Michael Both> Ferrus Buehler's Day Off

<Michael Both> A movie about a kid who skips school

<Nathan Hughart> hmm

> I want to thank Jason Smith for spending a part of his evening with us. Thanks!

<Nathan Hughart> never heard of it...

<Nathan Hughart> ditto

<Nathan Hughart> thanks m8

<Jason Smith - NASA> Thanks guys. Hope to see some of you this summer. Good luck with the rest of your school year.

<Michael Both> thanks

<Sarah Stephen> thanks!

<Nathan Hughart> so we shall see you this summer/

<Nathan Hughart> ?

<Nathan Hughart> cool