Preflight Interview: **Dominick Gorie**

Before we get into the specifics of this flight, I want you to tell me a little bit about yourself. Why did you want to become an astronaut?

The earliest memories I have are of wanting to fly. I always knew I wanted to do that. My natural father was a Pilot in the Air Force, and I remember sitting on the hood of a Buick at the airport watching big bombers fly over our heads and that was the most exciting thing I could imagine. I got into the Naval Academy and went into flight school and started flying F-18s and had a wonderful time. I remember also as a young boy watching the earliest Apollo missions and watching guys walk on the moon. That was a dream of mine but I couldn't imagine myself being that fortunate. I think once I became a test Pilot and saw that now the doors were open for me to apply to be an astronaut, I did that with everything I had. I think there are hundreds and thousands of people out there that are just as capable as I am to be an astronaut. But, for whatever reason, NASA decided to let me come do this and I'm having a great time.

Now tell me a little bit about the particular path that got you to this point. How did you get here?

I flew F-18s in the Navy and A-7s a little bit before that so I am used to flying single seat airplanes. I had a great time with each tour that I had in the Navy, and each one actually got better, I thought. As a test Pilot, you experiment with different airplanes and different systems, and NASA likes to see that background in their Pilots, so they pretty much have that as a requirement. Once you have that in your resume, you can apply to come to NASA. I had to apply a couple times before they relented and let me join the Astronaut Office. I would say that my background is mostly flying single seat airplanes and then I was a test Pilot.

Summarize for me what you'll be doing during this flight. What are your primary responsibilities?

The Pilot is in charge of the main engines, the hydraulic systems and the electrical systems during the ascent and entry phases. Once we get on orbit, Kevin will put me in charge of the Blue Shift. Once he, Gerhard and Janet go to sleep, I'll be running the Blue Shift with Janice Voss and Mamoru. I'll be in charge of the basic shuttle systems and how the shift is run during those times that we're awake. When we're on orbit, I'm doing some attitude maneuvers and orbit adjustment burns as well as helping out the two Mission Specialists on the payload.

This mission will look back at the Earth using radar interferometry to acquire topographic data. Could you explain for me - what is that?

I think most people have a basic understanding of what radar does; it will send out a wave that will return an image of the ground. On this flight we have two antennas that are looking at the same radar return and they look at the phase difference in the return wavelengths. If you can think of two waves of water returning from the same source but going to two different points, the wavelength might hit those two different points at different places. Where one person standing in the water might receive the top of the wavelength, or the wave, a person standing two feet behind them might receive the trough, or the bottom of the wave. When you compare those two differences in the wavelength, that's called the phase difference, and the difference is totally due to an altitude difference. So if you go into the geometric analysis and look at the baseline distance between the two radar antennas and use the phase difference between those two returning wavelengths, you can determine the altitude of the source that you bounce that radar wave off of. When you can add that to the radar picture, you can build a 3D image of the terrain that you're mapping.

The Shuttle Imaging Radar-C, or SIR-C, and the X-band Synthetic Aperture Radar, or X-SAR, flew on the shuttle in April and October of 1994. What are the innovations for SRTM to separate it from the first couple of Space Radar Lab missions?

The biggest and most obvious difference is the huge mast that will be sticking out 60 meters or 200 feet. That will give us the baseline difference between the main antenna and the extended antenna and that will allow us to measure the phase difference or the difference between the return wavelengths. That's what will give us elevation data. The previous flights were not getting any elevation data; they were just mapping the surface in the picture of what they were looking at.

Please tell me about the mast deploy. What happens during that process?

What's really interesting about this 200-foot mast is that it is in this relatively tiny canister and that it can extend out 200 feet in a unique and innovative fashion. Most garage door openers use a screw drive that continuously drives the garage door open and some of them might use a chain. But the screw drive one is what we have at home. This is a similar system, although the screw drive doesn't go continuously in the same direction. It will reverse for each bay that's extended, and we have 87 bays that make up this 200-foot mast. As each bay opens up and locks into position, the screw drive will reverse its direction, and so the mast is uncoupling all the way out for 200 feet. We've seen a small model of it and small extensions of it during trips to the Jet Propulsion Lab. But I think to see it in real time and real life once we get on orbit is going to be great.

What happens if the mast does not fully deploy? Can you do an EVA to fix the problem?

There are a couple things that we can do to fix a stuck mast. First, if the latches don't open on the canisters, Janice and Gerhard are prepared to go out and do an EVA to manually open those latches with some special tools. We could also have a motor problem that prevents the mast from fully extending, and they have these huge pistol grip tools that are amazing pieces of machinery. Most people, I think, are familiar with small hand tools or drills or electric cordless screwdrivers. This thing really puts those to shame, and it is quite massive. But in zero-g they're easy to handle, and they would go out with a couple of space batteries and manually put this power tool on the screw drive, pull the trigger, and wait for the mast to deploy manually. They would have to take turns doing that because it would take quite a long time, and they have spare batteries to swap out as they extend it.

I understand that the length of the boom creates its own set of problems. What is the gravity gradient force, how does the boom affect it, and what are you doing to counteract it?

The gravity gradient force comes into play whenever you have two different bodies that are connected together in space. Because they're traveling, in essence, at different speeds around the Earth, there's a force called the gravity gradient force that will try to pull them apart. Think of a car going around a corner and the people that are inside are thrown to the outside of the turn. Those two bodies in space will line up with the centrifugal force vector or 90 degrees out from our velocity vector. That means that the antenna and the orbiter are lined up with each other with the orbiter closer to the Earth and the antenna pointing away. The force that is driving that is only a couple of ounces. So we've designed a system using nitrogen that comes out of a small nozzle at the tip of the antenna that only emits about a one or two ounce force. That pushes the mast down when it's trying to achieve its gravity gradient condition which is pointing straight up, but the cold gas pressure from the nitrogen gas is pushing down at an equal and opposite force of two ounces or so to hold it right where we want it. That way the orbiter's not constantly using reaction control jets to return it to its desired attitude.

What is the fly cast maneuver, and why are you using it?

Think of a fisherman standing out in the middle of the river fly casting his rod back and forth. That's what would naturally happen to our mast if we were to disturb it. So I brought a small model here to show this. We've got this mast sticking out from the space shuttle. Once a day, because we're at a fairly low altitude, we have to adjust our orbital altitude. We do that with a couple of reaction control jets in the aft end of the space shuttle. If we were to do that without thinking about the ramifications on the mast, we would pulse on the back end of the orbiter with the reaction control jets and the mast would deflect backwards because of its mass and inertia. Once we stop the burn, if we let it go the mast would swing back and forth. What we have designed is a maneuver that will minimize the deflections on the mast and minimize the loads at the tip. If we did this without the fly cast maneuver, we would have a 35-inch deflection at the mast tip, and we would approach the mast limit loads at the base. So we pulse just for a short time - 1/6 of the natural frequency of the mast - and the mast will deflect back slightly. Right when it starts springing backwards, we will pulse again and in essence catch it in its deflected state. We are then burning the reaction control jets for the duration of the burn that it takes to adjust our altitude. When we stop the burn, the mast wants to start swinging back and, if left alone, it would start fly casting again. It would start twanging back and forth just like that fly fisherman's rod. As it reaches back to its neutral position, we do one more pulse at 1/6 the frequency of the mast for that duration and catch it in its neutral position. That way we take those 30 plus inches of deflection that we would expect without a fly cast maneuver and we half it to 15 inches and the mast loads at the tip are halved as well. What we've done is designed a maneuver that achieves our end parameters but greatly reduces the risk of damage to the mast.

What could be done if you had trouble with the retraction of the mast? For example, could it be jettisoned if it got stuck?

We've got two things we can do. First of all, we could send Janet and Gerhard back out there with those power tools that we talked about previously, and they could hook them up to the drive motors and retract it manually if it was a motor problem. If it's something else that's stuck like a bay that we can't get to and we don't have the capability to EVA out on the mast, then we have a jettison system that will deploy some pyrotechnics and release the mast from the payload bay. Then we can do a normal back-away maneuver like we do with any deployable satellite. Then, in that case, the mast would be lost, but we would be able to close the payload bay doors and come home.

On the surface, this flight has similarities to the Tethered Satellite System flights because you're deploying a long system out of the cargo bay. Do you anticipate having any of the concerns similar to those associated with those flights?

The Tethered Satellite is a completely different system. I think when you talk about deploying something on a loose cable out to the distances they were talking about, you can't really equate that to what we're doing. What is consistent, though, is that we're trying to do something that nobody's ever done before. No one has ever tried a Tethered Satellite deploy, and no one's ever tried to deploy a rigid structure this far out from a space ship or a spacecraft. So in that respect, we're both trying something innovative that has some unknowns to it. You can make some parallels, but I think that's about it.

On the SRL missions, they had specific mapping targets on their surface. Do you have anything like that on this flight?

Our flight is attempting to map all the landmass that we can. We're not turning the radar on and off just for specific spots over the ground. What we're doing as we cross a continent or an island or any landmass is we're turning the radar on and we're leaving it on for the duration of that land pass and once we get back over the water then we turn it off. I think our goal is to get a much broader database on land returns.

You mentioned that you turn the radar off when you go over the oceans. Do you turn it back on, for example, when you go over an island mass of some sort?

The Jet Propulsion Laboratory and the SRTM folks have a detailed plan already in work on when those data takes will start and when they will stop. They will cover islands when they can get them, as well as the continents. So we will try to map every land mass that comes up.

Why is the data being recorded instead of downlinked live?

The recording rate, I think, that we're getting is almost 9 kilobits a second, and right now we don't have the capability on the shuttle to downlink data at that high rate. We just don't have the communication equipment or systems to do that. So we've got some recorders that we use that record in high data rate on some special tapes. We record at that data rate and fill them up in about 30 minutes of C radar data. The X radar data will fill up a tape in about an hour, but once the flight is complete, we're going to have a huge amount of data. I think that the number is 8 or 9 terabytes which is something I can't comprehend. I think somebody told me that if we stacked CDs with that much data, it would take 15,000 of them on top of each other to get as much data as we're going to get on 300 tapes.

You're getting this massive amount of data. How long is it going to take to process all this?

I have heard some other analogies as well. I think NIMA expects to take a year or two to process all of it. But the analogy I heard was if you had 144 Pentium computers running twelve hours a day, it's going to take you 140 days to process all that data.

What will we learn about the Earth from the data you do acquire on this mission, and what kind of applications are there for what you're going to learn?

NIMA is an organization that works for the government, and they have some national security concerns and uses for that data. Along with that, there are many Earth sciences people that are very interested in what we will bring back. NIMA and the German DLR folks that are running X-SAR are going to make that data available for different scientists and engineers that are interested in many aspects of Earth life. If somebody is interested in building a dam, they would want to know what the elevation data would indicate and where they could build it. Mining engineers would want to know where they could go exploring and what elevation is going to mean to them once they go into an interior part of the country. People that are interested in terrain following for airplane piloting or air traffic control would like this kind of data. Or for people that are interested in recreational uses, such as hiking or camping in the mountains, we can have great maps built for that. I think the possibilities will unfold to us, but right now the Earth sciences people are really excited already.

Once the payload is functioning properly, the crew slips into a pretty regular routine. Do you think the work will get boring or tiring for you up there?

I think that although the work will become regular and routine as far as watching data takes and swapping out tapes on our recorders, I can't imagine ever thinking that space flight would get boring or routine. When you think about the data that we're bringing back and what it will mean to the scientists and engineers that are looking forward to receiving it, it is unbelievable. And if that doesn't excite you enough, just looking out the window can fill your time. We've got a couple of other small payloads that will keep us busy, like GPS, the Global Positioning Satellite experiment that we're running. We've got a couple of things that we're working for NASA. A big high definition TV, a group of data takes or film takes that we will make during the flight. So there's plenty to keep us busy, and I can't imagine we will ever get bored with it all.

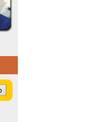
One of the other payloads is something called EarthKam. What can you tell me about EarthKam?

EarthKam is a system that's set up for students in their schools to work real time with the space shuttle. They can send commands up to a computer on the flight deck that's running the EarthKam software. The EarthKam is connected to a digital camera that's located in the overhead window; and they can command times, latitudes, and longitudes for when they want their camera to take pictures. They can program on the ground what they would like to take a picture of, have it taken on orbit and then downlinked, and they can actually see what the space view of that terrain is. And they can then see what scientists and engineers do for Earth effects and Earth studies from real time work. And it's exciting, I think, for students all over the country to get involved real time with what a space shuttle experiment is doing on orbit.

How would you characterize the long-term importance to science of the work that you and your crewmates will be doing on STS-99?

First of all, when we deploy a rigid structure in space, it will enable us to learn many things about engineering and building in space. If we want to build some large structure on a space station or on a visit to another remote planet, doing this and demonstrating this capability is very important, I think. The data that we bring back from the flight will be extremely important to NIMA for its national security reasons, as well as to all of the Earth sciences scientists and engineers. I think there are many uses for this data that we probably don't even know about. Once people can see that the data's available, they'll come up with many uses for it that we don't even anticipate.

Greetings



Click on the image to hear Dominick Gorie's greeting. Pilot, STS-99

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