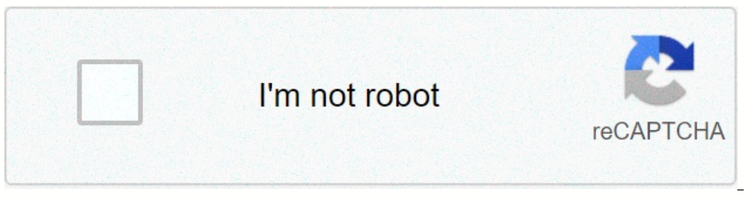

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Star citizen engineering manual

It's really great to see so many of you take space to try the first taste of what space combat will be in Star Citizen. Me, like the rest of the team have been eagerly watching Twitch feeds of supports play and read the forums for your comments. Two of the hot topics of the debate were the flight model and the advantage or disadvantage of various input devices. So I thought I'd take a moment of your time to share an overview of both topics. Flight model Most space games (including my predecessors) greatly simplify simulation, usually as a model of non-gravity atmospheric flight and air resistance - ships have preset pitch, roll and yaw rates, linear acceleration (which is applied to a simplified point mass) and a capped top speed. When you want to turn, the joystick or mouse input is mapped directly to the specified turn rate unrelated to the ship's moment of inertia. Damage is generally treated as multipliers on turn rates and linear acceleration. Star Citizen doesn't do that. We model what would be needed on a real spacecraft, including the correct application of thrust to places where the thrusters are attached to the ship's hull - in our model moment of inertia, mass changes and counter-push are very necessary. Star Citizen's physical simulation of spaceflight is based on what would actually happen in space. There were a few reasons why we went in that direction - 1. Because we intended to model and simulate spaceships with a fidelity that had not been seen before I felt that we needed a simulation that would allow the player to have a different flight behavior if a propeller is damaged, a wing is blown or a pilot overloads his ship with weapons and ammunition? I wanted a system that could feel distinct for a wide variety of ships, with very different sizes and roles because in Star Citizen you can go from a single-seat ship of 15 meters in length to a huge capital ship of more than 1 km in crew size by many players. I wanted these ships to come with their own identity and feel a bit like cars of similar size, even if the mass equivalent may feel radically different. I wanted ships to have their own personality — not just a slower, faster version of the base ship. 2. The second is that Star Citizen will have a significant amount of player vs. combat player. I don't know how many people played Wing Commander Armada (the first Wing game to present multiplayer), but it wasn't much fun in battle mode (head-to-head mode). When you design a solo game, you can deliberately mute down the AI to allow the player to get on the tail and shoot down several enemies, giving the player a sense of accomplishment. There's nothing more fun than clearing a wave of 10 Kilrathi enemy fighters. But let's be honest, in solo games the ability to Shooting down waves of enemies has less to do with the skill of the player because the player is usually mastered compared to the basic enemies he is fighting. You can't do it in the player vs player, and it's likely that several players will have the same ship. Without a sophisticated simulation and flight model, with many options for a pilot to try fluidly different tactics to gain the upper hand over battles can end up as a frustrating stalemate when both pilots have the same ship that no one can get on each other's tail because you don't have the same forces that affect air combat (i.e. gravity and air resistance) to bleed the energy of maneuvers. These are the reason why we did things to fully simulate physics that would involve controlling and moving a ship into space without shortcuts. In the same way, we also simulate ship systems. Each function is related to individual elements that are connected to the ship - weapons, thrusters, power plant, heat wells, radar, fuel tank, batteries, targeting system, processor, HUD and even the intelligent flight control system (IFCS) are all elements that connect to various pipes that connect the systems - there is a pipe for energy , heat, fuel and CPU cycles. The targeting computer needs power from the power plant and CPU cycles of the ship's computer, positional radar information to solve targets. If there aren't enough CPU cycles to bypass the targets will resolve more slowly, not enough power and the targeting computer can stop working all together. If you don't get enough heat from the weapons, they can overheat, malfunction or even be damaged. If one of your wings is blown with its thermal sinks attached, you better reduce your heat production. By fully simulating both the systems and physics of powered spaceflight, we allow a huge amount of emerging behavior and variety in the final game. The ship's load becomes very important not only for functionality, but also for actual flight and responsiveness. Just like in the design of real military aviation, you might decide to have redundant systems for better combat survival or you could maximize your strike power at the expense of maneuverability. Sounds pretty cool, doesn't it? So why all the fuss? An appropriate space flight simulation is inherently different from an atmospheric flight model. In space, there is no aerodynamic force (lift or drag) and therefore inertia and linear becomes much more important. Unless you apply a counter-force to stop the angular or linear momentum of an object in space, it will continue unchanged. When a player backs off on the stick, the thrusters apply thrust to create a rotation, which accelerates the vessel's angular speed. When you let the stick go back to zero or move it the other way around, the IFCS must now apply the reverse thrust to first demote the angular velocity, then move to the desired new angular speed. Unless the ship has extremely powerful thrusters, this will not happen instantly. Since the IFCS is not far-sighted and doesn't know when you want to change angular speed, it can't anticipate your actions, so unless the driver himself calms down in his desired direction, it's likely he'll overtake him. Think of it as stopping in a car; you normally have a good idea of your stopping distance and so when approaching a stop sign, you start to slow down. You don't expect to go from 50 mph to zero instantly. This behaviour is very different from an aircraft using control surfaces that alter the airflow over the wings/tail to manoeuvre. In this case, the angular velocity change is normally directly proportional to the rudder/volet position. This means that, to some extent, you need to anticipate where you want to be and relax in that position. If you are used to an atmospheric model on the first flight in a model where momentum is much greater, it is quite easy to exceed your desired course. Then, as the counter thrust is not instantaneous, you can overcorrect the other way. This is why the ship may feel nervous when trying to align a target. Because it is different from what people are used to, part of our community clearly believes that the current flight model is wrong. But if you think about what we're doing, we're actually allowing a lot more variation and nuance in flight and combat than a simplified Wing Commander/X-Wing style flight model. Like learning to drive a car really well... it takes a little learning. You need to anticipate where you want to be and plan for it. Does that mean that I think the system is perfect? No! That's one of the big reasons we wanted to put it in your hands. It was great to see people playing the game and providing their feedback. It was really great to see a lot of people who hated the flight model first, coming to see its potential after other members of the community shared their ideas. This does not mean that everyone is sold, but it is always comforting to see people being open to new possibilities. But that doesn't mean I'm happy with where we are. My goal is to have all the nuances I describe above for players who want to go deep, but also make it accessible in the way Wing Commander was for someone new to the game (and the genre). The key thing to remember is that the system flight control is just the interface between the physical simulation of the ship's movement via its thrusters and the force they exert. That is not the model. I see a lot of messages talking about the desire for Newtonian mode. The physical simulation is already a complete simulation of the Newtonian rigid body. For what we are trying to achieve it will always have to be a fly by wire between player entry and real physics because no human can simultaneously direct eight thrusters simultaneously, specifying their thrust and attitude to achieve the desired movement. Within the limits of physical reality, IFCS can do just about anything we want. The key is to determine what we want the player's entry to the card to. The first pass of different modes - basic IFCS, De-Coupled, G-Safe and Comstab are all different modes that we think would be useful at different times. This does not mean that this is the end of modes, or how they are implemented is the only way they will be. Many people have asked for true 6DOF available all the time - basically having strafe available during normal IFCS flight mode and making additive strafe at ship speed in decoupled mode. These are all things we will experiment with, with lots of other options for example, an additional G-Safe mode that is to rotate limited rather than limited speed and we will also play with the power of the thruster as currently the maneuver thrusters are about half to a third of the main engine power that is sufficiently controlled Just be warned that the more the thrusters will slide vector front speed to the desired direction. To give you even more details on how IFCS works, John Pritchett, the engineer who wrote the current implementation of IFCS, wrote a detailed article that goes into detail about how the system works. I hope you will all appreciate the level of detail we aim for in Star Citizen. Remember that there is so much more to the game than just Arena Commander - and even in Arena Commander there are so many things that can't yet be appreciated that we're stuck with an ongoing HUD work and lack of elements to equip your ship with - both of which will open up new possibilities and tactics. Control devices There has been a lot of debate about mouse control vs joystick control and the concern of a part of the community that the mouse scheme makes the game too arcadey and hotas users feel that their control mechanism of choice has not been supported properly. First of all, let me say that the goal of Star Citizen will be agnostic controller. No control mechanism should have an advantage over others. Personally, I am a joystick driver (either by HOTAS or Gamepad) as opposed to a mouse driver. I just feel like I have a more accurate flight control with a joystick. In our various studios there is a wide variety of controller use - some prefer the mouse, some joystick, HOTAS and some gamepad. This is the best guarantee that any mode of control will not dominate. That said, we recognize that control input systems need to work in flexibility/personalization to achieve this goal. One of our top priorities for Arena Commander is to enable users to their key links form inside the game. We are actively working on it and hope to deliver something next month. We will also work on the different HOTAS profiles, as well as the fine control filtering setting for the controllers in order, hopefully, to allow sharper maneuvers during smaller movements of the stick. There are also some additional head-eye modes that have not yet been implemented that will allow a joystick player to enjoy cardane weapons the way the mouse player can. And of course, if you feel the mouse, with its greater precision allows to aim better, you can always fly the ship with a joystick and watch with a mouse! Lace vs. Roll There have also been discussions that the yaw does not affect your pilot in terms of negative effects of G (i.e. the black and red of G vertical forces). There are a few things to consider here. First of all, pure yaw turns, without any bank, are certainly possible in space, but this is not the optimal way to turn. You can generate more thrust by combining your lateral and lower thrusters as you can with only your lateral thrusters. IfCS automatically bankes a ship to optimize its rotational thrust, and this is where G vertical forces come into play (note that this is different from atmospheric flight where banking is necessary to ensure turn stability). Second, the amount of bank in any yaw ride will depend on the amount of lateral thrust your ship can provide, meaning that the amount of G vertical forces in a yaw turn varies depending on the situation. Third, black/fearout and loss of consciousness are consequences of vertical exposure to g-force only, where blood is drained or forced into the pilot's head. Properly constrained pilots can withstand very high levels of horizontal G-forces without significant loss of cognitive ability. For horizontal g forces, the limiting factor is structural. Unfortunately, this limitation has not yet been implemented in our model. Once it is, there will be consequences for extreme turns not banked. Instead of blackening, you can pull off a propeller or wing the size of horizontal Gs. And if activated, G-safe mode will ensure the structural integrity of your ship by limiting the amount of thrust in any maneuver. Tourelle Part of the community expressed concern about the ability of players to turn around in decoupled mode and turn around their target, does this remove the skill level of dog fighting. I know that people think that, but I can assure you that in our internal multiplayer tests enough no one decouples exclusively and turrets as they would be destroyed very quickly. The key to surviving a dogfight is to be constantly in motion and not be predictable with your movements - sitting still or moving in a constant vector (which is what happens when you you will have you killed. Decoupled mode is best used by going briefly for a quick change of orientation, then rettuated to coupled mode. As we fine-tune the power of the manoeuvring thrusters to make the main engine more important go into decoupled mode, making a quick change of orientation and returning to normal flight will be a great way to maximize your available thrust for a rapid vector change. I know some people think that being able to change your orientation much faster than you can in an atmospheric flight sim makes the game easy, but this is a space combat simulation not an atmospheric flight simulation and the ability to decouple your orientation from your speed vector is absolutely something that would be used - and remember a huge amount of community required to be able to do the maneuvers you liked! Carded vs fixed weapons in the V1.0 Commander Arena (and Star Citizen as a whole) there will be both fixed weapons and cardane weapons/turrets. Fixed weapons will have a slow automatic convergence of perhaps -/-- five degrees to allow them to focus at a point that is user-definable (by default at half the maximum range) or will adapt to the distance of the current target. We didn't have time to complete this feature, so for v0.8 we just made all the carded fixed weapons so as not to give the Hornet a huge advantage over the Aurora and 300i. That is not the long-term plan. Fixed weapons will have an advanced indicator (just like in a real fighter aircraft). We are also considering changing the operation of carding guns. Right now, you just have to place it on your target and targeting computer because in the guns to reach this shooting solution, when the dotted lines collapse inside the retical, it means that all the guns have reached the solution. We are thinking of doing so so you need to place the look reticle on the lead indicator in order to achieve the shooting solution. This will allow a pilot who doesn't use all the power of his carded guns (it's not always easy to aim and fly in two different directions or if you're in a combined look and fly mode like the Freelancer mouse mode) to fly in a more optimal way to lead the target (you want to head to where the target is not heading where it is now) As for people thinking that cardane weapons spoil the skill in the game, cardane weapons/turrets are a pillar of current military equipment and will probably be even more so in the future. This does not mean that a blow is The weapon has yet to come to carry on the target and you must be pointing at the nose of your ship so that the firing solution can be filled. And that's assuming the target doesn't start to change course or speed erratically! — Chris Roberts Roberts Roberts