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Attitude control is quite a crucial subsystem of any spacecraft or satellite. Not only does it provide stability to the payload but it also ensures that all systems are pointed with accuracy. The needed accuracy assists the spacecrafts' antennas to point at a specific location for communication, let that be the earth or another spacecraft. Attitude control is the key for success for any mission. Without it, spacecrafts and satellites would either be pointing cluelessly into space or spinning out of control in their orbits. This would render all of our spacecrafts useless.

There are many sensors that determine a spacecraft's attitude but the issue relies in the actuators for stabilizations. All the stabilization actuators that are used today have a weakness that limits each one in their own way.

The first form and most commonly used attitude control system utilizes thrusters, commonly referred to as Vernier thrusters; can be quite heavy and the plumbing system requirements for setting them up is also difficult to work around. Thrusters also need fuel to fire, and while multiple fuel supplies have been used for thrusters, such as cold gas or chemical mixtures, these supplies are ultimately limited and cannot provide function for long. Even though larger spacecrafts that need powerful thrust use them, their uses in new designs are now seldom due to their setbacks and inefficiencies.

Spin stabilization and momentum wheels are also used for attitude control. These systems also have their issues. They both rely on spinning mass. Spin stabilization systems spin in to maintain attitude especially on the final stages of a launch, but they may need to be de-spun and their contingencies rely on the spacecraft's lack of extremely high precision. Similarly, momentum wheels are spun to gain momentum on different axes and small changes in those momentums can orient the spacecrafts but they need to be used with magnetic bearings because friction would break them down faster, and additional wheels are most often used due to failure protection needs. Precision and longevity with these systems is an issue, not to mention that over-spinning and losing control of a wheel will cause major setbacks.

Control moment gyros also contain spinning rotors, they are more expensive and weigh more because they also provide a large momentum change, making them suitable for a large spacecraft. The issue with control moment gyros is that they are too expensive, considering they are extremely complex and requires the use of additional units to compensate for their abundant failure points.

Solar sails, while new, are still not a good method of attitude control for emergency and high torque attitude controls. They utilize the incident of light hitting their "sails" to produce a small reactionary force. This force is very small and is more suited for long missions with small spacecrafts.

Gravity-gradient stabilizations, are used with spacecrafts with uneven lengths at their axis. The upper end of the axis feels a less gravitational force than the lower one and the restoring torque is applied when the longer axis isn't parallel with the direction of gravity. Because a large distance is required for the setup, long conductive tethers are used to connect the two parts of the spacecrafts, longer tethers means increased torque. The downfall is that small meteoroids or debris in orbit can snap the tethers apart and a large configuration area is also required for setting up these ends.

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Magnetic torquers are used in a form of either coils or permanent magnets. They exert a small torque against the magnetic field to stabilize the change in attitude. The issue with this method is that it only works where a magnetic field is present and it can't produce high torques or be controlled at more than two axes at any given time. Additionally, the earth's magnetic field varies a lot and doesn't produce an ideal uniform field.

A branch of Gravity-gradient and magnetic use gives us our Pure passive attitude control system that stabilizes the spacecraft with four state axis. The smallest axis with inertia is pointed towards the earth and flipping the satellite would mean rotating the tether end to end. The magnetic method uses the earth's magnetic field similarly to the magnetic torquers. These systems have limited pointing accuracy due to energy minima they encounter and dampers need to be used, which also cause additional heat to the system when they convert the oscillations.

In summary, the current attitude control systems all have setbacks: limited fuel, inefficiencies, longevity issues, precision issues, environment vulnerability, small torque forces, and lack of accuracy in controls.

A universal system that can be shrunken or enlarged to the needs of the spacecraft's attitude control without these setbacks is needed. By eliminating all these setbacks in a new attitude control system, future spacecraft subsystems would be able to experience all the positive features of attitude controls without the negative byproducts. The beneficiaries to a more reliable and precise attitude control system range anywhere from commercial companies that utilize satellites to government research spacecrafts and military satellites that require the best performance. Being able to provide a more reliable, accurate, and versatile attitude control system could boost the longevity and accuracy of all future space missions, enabling them to be more efficient overall.

Technologies that require more accurate and alternative attitude control would be able to be sent to orbit, thus widening our research abilities and opportunities.

By utilizing Ferrofluid, an attitude control system can effectively be a hybrid of many of these systems already put in place. You can enclose ferrofluid in its own system, effectively bypassing longevity and mechanical failure possibilities. Ferrofluid is controlled with magnetic fields, so a magnetically induced field surrounding the ferrofluid can control it at a distance, this would enable the user to set the system at many different locations without the need of close or physical contact to the induced field. The ferrofluid can be spun to act as a momentum wheel, it can be transported to different end points or reservoirs to act as a Gravity-gradient stabilization system. Ferrofluid can also be split up, so that the right amount of mass can be accumulated and put into the attitude control system, giving us the option to have more or less of the mass spun, and splitting up and transporting different amount of the fluid to various locations. The increments of which you split up the ferrofluid can be whatever you desire. This is very important because it opens up an attitude control system that can adapt and change to the needs of your situation. Having a variable mass that can be transported, spun, and manipulated in any way with an induced magnetic field provides the user with a huge range of torque and accuracy tuning.