Internship Report

Lockheed Martin Aeronautics Company
F-35 Program – Quality Technologies

An internship performed at:

Lockheed Martin Corporation

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Preface

This report seeks to describe my internship at Lockheed Martin Aeronautics in Fort Worth, Texas, USA from January to June of 2018. While the report will cover what it has been like to work for Lockheed Martin Aeronautics in the Quality Technologies team, it is not my intention for this report to go into much detail about technical or engineering related topics, but rather focus more on the experience of traveling to Texas to live and work for almost half a year with seven other Danish engineering students. I believe that this will be of best relevance for the intended readers of this report, i.e. future potential interns. The report will give potential interns an insight into the internship and what to expect, while also serving as inspiration for what is actually possible during the time in Texas.

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1 Introduction

Since 2003 engineering students at Delft University of Technology have had interns at the Lockheed Martin Aeronautics facility in Fort Worth, Texas where primary production of the fifth-generation fighter aircraft F-35 Lightning II takes place. In 2015 the first team of Danish interns consisting of two engineering students from Aarhus University were sent to Fort Worth, following a collaboration between Lockheed Martin, Aarhus University, and the Danish sub-contractor for the F-35, Terma A/S. In the following years new teams of Danish interns have went to work for Lockheed Martin, with students then also being selected from the Technical University of Denmark, in addition to Aarhus University. In the year of 2018, the Danish team consisted of eight engineering students, with all being selected from the Technical University of Denmark.

Figure 1: Air Force Plant 4 (left) in Fort Worth, Texas houses around 16,000 employees and serves as the headquarters for Lockheed Martin Aeronautics as well as primary production facility for the F-35 (right). (http://www.huitt-zollars.com/tran-avia-termindcarfac/termindcarfac-lockheed-martin-various-projects https://en.wikipedia.org/wiki/Lockheed_Martin_F-35_Lightning_II#/media/File:F-35A_flight_(cropped).jpg)

The Danish interns have in the previous years been assigned to work in the fields of Quality Engineers, focusing on finding and eliminating defects and their causes in the production, and Manufacturing Engineers, with the objective of improving work flow and production rates. New for 2018 however, was the introduction of the Quality Technologies positions for the Danish candidates. The Quality Technologies team, also known as QualTech, is a new team at Lockheed Martin which was started in early 2017. In the second half of 2017 the team had its first Dutch interns from Delft University of Technology. The main objective of QualTech is the implementation of new technologies to improve the quality inspection processes at Lockheed Martin Aeronautics.

While coming to Texas to work for the world's largest defence contractor is in itself a very significant experience for an engineering student, a very large part of the internship experience has also taken place outside the large factory walls and guarded gates. The biggest highlights have been the many trips around both Texas and other states. With every other Friday off there were good opportunities for these longer trips. These have included various air shows, hiking in national parks, attending motorsports events, and much more.

2 Preparations and Arrival

From the moment all the interns got selected there was a lot of preparations to be done. The first thing was to start the visa application process, as it is a very slow with many steps and papers that need to be filled. It can also be recommended to begin looking at flight tickets early on, in order to get the best deals. Most of the interns chose to have around a week in the Texas before starting the internship, in order to get used to the way of living and figuring everything out like car registration, insurance, and phone contracts. At the other end after the internship is finished, some of the interns choose to leave immediately, while others decided to spend two extra weeks in the USA, in order to have time for something like a longer road trip. Just keep in mind that while the visa covers a period from 30 days prior to the internship start to 30 days after it ends, the travel insurance that is supplied for the internship only covers two weeks in both ends.

As most of the new interns did not know each other, it was also important to establish a connection between everyone, as a way to share information. For this a Facebook group was used. The easiest way to share expenses for Danes is a phone application called *WeShare,* which is highly recommended. Additionally Terma invited all the new interns, as well as the previous year's interns out for lunch during the summer. This was a very good event even though a few people were missing. It still allowed the new interns to get to know each other better, as well as let the old interns share their experiences and recommendations for the internship. The interns met up a couple more times to discuss planning, as it is easier to get things done when everyone is there physically, rather than doing it through mails and online messages.

The Dutch intern team of 2017 contacted the Danish interns around the end of October. This was to begin setting up a deal for the transfer of inventory and cars, and also provided some useful information about the different costs of living in Fort Worth. They also provided a contact for Marquis at Stonegate, to set up leases of apartments. Having the different intern teams staying in the same apartments, and simply transferring inventory and cars between them seems to be the ideal way of doing things. This way the leaving team does not have to go through the process of selling everything individually, while likely only getting a small part of the initial investment back. Similarly the arriving team will save a lot of time and money by not having to go out and buy cars and furniture the moment they arrive. It is

Figure 2: The pool area at Marquis at Stonegate with grill area to the left, and the reception building in the back which also houses the fitness area. (https://www.cwsapartments.com/marquis-at-stonegate-fort-worth-tx)

basically a win-win situation and hopefully a tradition which will stay for future teams. The 2018 Danish intern team had 3 apartments. They were located on the first, second, and third floor, respectively and were pretty much on top of each other, located next to the pool. Each apartment had three bedrooms, two bathrooms, and combined kitchen and living room area.

While the cars bought from the Dutch were cheap, they were still all old high mileage cars. None of the cars were trouble free, which meant there were a lot of bills for spare parts and repairs. The cars were a 2006 Volvo XC90, a 2006 Chevrolet Aveo, and a 2007 Ford Focus ST, with the last two having manual transmissions. The Volvo was a nice big practical car, while the Ford was actually a very fun car to drive. The Chevrolet was in general just a bad car that felt very cheap and with no power, even by Danish standards. The car was bought by the 2017 Dutch team and even they admitted to have paid too much for it. If any of these cars are still around for future interns be careful before buying them, making sure they do not carry any known serious faults. Also if buying cars from another intern team, be careful about when the cars are due for inspection. The cars need to be inspected when transferring titles. Transfer of titles takes place at a Department of Motor Vehicles and also require signed documents from the previous owner, proof of insurance, and paying sales tax.

Figure 3: The 2007 Chevrolet Aveo in bright red which was one of the three intern cars for 2018.

A problem with living as a foreigner in the USA is a lack of credit history. This usually means any kind of contract will be more difficult to set up, and often requires a lot of documentation and deposits. This was for example a problem when trying to set up an electricity plan for the apartments with TXU Energy, which required a very large deposit. It is recommended to setup an electricity plan prior to arriving. Car insurance also got expensive because of the lack of credit history. Also be careful when selecting a car insurance. While the minimum legal liability limit is 30,000$ for each injured person, up to a total of 60,000$ per accident, and 25,000$ for property damage per accident, this is likely not enough to cover much because of high medical bills if injuring someone else. Consider going with higher limits, which are not much more expensive. The 2018 Danish interns used State Farm. Phone contracts are generally more expensive than in Denmark. The Danish team all used prepaid AT&T contracts for around 40$ a month for 6GB of data, which was fast and easy to setup.

The arrival in Fort Worth went very smoothly, thanks to Andre and Camilla Carter that picked up the first guys, served them diner and drove them to the apartments. They seem to enjoy helping the intern teams, which is much appreciated. Additionally, Brad and Travis who also live at Marquis at Stonegate have been in touch with interns for around 20 years. They usually also help the interns when they arrive, as well as show them around and hang out with them.

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3 Lockheed Martin Aeronautics

Lockheed Martin is an American company formed in 1995 by merging of Lockheed Corporation and Martin Marietta. The company primarily operates in the business areas of Aeronautics, Missiles and Fire Control, Rotary and Mission Systems, and Space Systems. Lockheed Martin is the world's largest defense contractor based on revenue and employs approximately 100.000 people around the world.

To the public the company is likely best known for its Aeronautics organization, especially in recent years because of the F-35 program, which many countries are participating in. Lockheed Martin Aeronautics has its headquarters at Air Force Plant 4 in Fort Worth, Texas and is also located in Marietta, Georgia, and Palmdale, California. The company has a portfolio of many well-known aircraft, which primarily come from the Lockheed Corporation before the merging in 1995. These for example include the C-130 Hercules, F-117 Nighthawk, F-22 Raptor, and of course the popular F-16 Fighting Falcon which was purchased from General Dynamics.

3.1 Working at Lockheed Martin Aeronautics

All of the interns were very excited on the days leading up to the start of the internship at Lockheed Martin. It feels very special being allowed as one of few foreign engineering students, to work for the world's largest defense contractor at the factory where one of the most advanced aircraft ever is build.

The first day began by going to the badge office to get the badges, followed by a joint briefing about the internship and rules at the plant. For example not being allowed to take any pictures at the plant, only being allowed there between 7:00 to 18:00, and restricted areas. Following this an onboarding event was supposed to take place, where the interns could be introduced to the company. This was however postponed due to construction work in the auditorium, and has still not taken place. Instead the interns were picked up by someone from their respective departments and escorted to their desks. The eight interns were located in three different areas. Four were located in the southern end, two in the middle, and two in the northern end of the factory. Some of the interns would sit in cubicles, while others would sit in offices. The following days mostly involved meeting new people and being shown around the production line and facility. From then on time was primarily spent working on various projects and assignments.

In the first couple of weeks some days were also spent on training. For example Plan Do Check Adjust (PDCA) problem solving, CATIA V5 CAD software, and Foreign Object Debris (FOD) approval. While training like the FOD approval was relevant and required in order to get near the aircraft on the production line, not all training classes were however of relevance for everyone. For

Figure 4: During the five month internship the interns got to try the F-35 simulator on two different occasions. This is also a rare picture of all eight interns together.

example only a few of the interns would actually use CATIA, and there was also training classes for software which the interns did not even have access to.

Once in a while various events would also show up. This for example included trying the F-35 simulator, meeting the Brian Mikkelsen, Danish Minister of Industry, Business, and Financial Affairs, and Jet Day where everyone could get pictures with an F-16, T-50, or F-35. It was also normal to head out for lunch outside the plant once in a while with colleagues, and various after work happy hour events usually also took place on a regular basis. Unexpectedly, around the end of April three new Danes also arrived in Fort Worth to work for Lockheed Martin. These were trainees sent by the Danish Metalworker's Union, staying until the end of June, as part of a new agreement between the Danish Government and Lockheed Martin.

While overall it has been very enjoyable working at Lockheed Martin, there have also been some small annoyances. Having worked as a student at a large Danish engineering company for two years, including a five month full time internship, there was already some ideas of what to expect before starting the internship at Lockheed Martin. When working at large companies, especially ones that have been around for a long time, everything just seems to go a little slower. This is usually because of the many layers and branches of the organizations, which communication has to go through. Simply finding the right point of contact for something can be a huge challenge. This has also shown to be very true at Lockheed Martin. Even basic tasks like moving a desk slightly, resetting a PC login, installing a display driver, or connecting to a printer on the same network and located on the same desk can easily take days, if not weeks along with countless of emails and phone calls. Some of the interns even had to wait days before getting access to their PC's at the beginning of the internship. Also unlike most Danish engineering companies, it is expensive to buy lunch at the plant. For some reason a Chick-fil-A burger is more expensive at the plant than at a restaurant outside the plant. This means it might be a good idea to prepare lunch from home.

Other than the problems that usually haunt large companies, there were also the challenges of working for a military supplier, especially as a foreigner. Being military related, there is a lot of security and rules surrounding everything. Badges must be visible at all times, some websites are unavailable, no photos allowed, and special encrypted USB drives must be used. Many areas of the plant are also restricted and usually require special badge access or escort. This is very annoying

when having to speak to someone, for example when the supervisor sitting in one of these areas, and then either having to tell the person to open the door, or getting escorted by someone else. Foreign contractors are also connected to a different network than the other employees. This greatly limits access to various internal sites, software and file sharing. It is not even possible to see other people's calendars and similarly the other way. There is also no windows in the factory, likely to keep everything inside secret. This means it can feel very isolated sitting in an office all day, without any idea of what is going on outside.

The interns follow the 9/80 work schedule, meaning 9 work days of 80 hours over two weeks. This results in every other Friday off, which can be used for longer trips. It can also be recommended to work overtime, in order to save up hours. This means it is then possible to take days off later on, for even longer trips.

3.2 QualTech

Previous years the Danish interns have only had the choice of working with either quality or rate transition. This year was then the first to introduce the Danish interns to the new positions at the Quality Technologies (QualTech) department. Two of the eight new interns were picked for QualTech. The Dutch have already had a team of three interns working for QualTech in the fall of 2017. Additionally, the department also had American interns in the summer of 2017 and also has research projects with various universities. As the name suggests, the primary objective of QualTech is to find and implement new technologies into the quality inspection processes at Lockheed Martin. This can for example be software that can detect defects, new tools for inspectors for improving quality inspection, or drones that can make certain tasks safer and easier.

Figure 5: Most of the QualTech team posing in front of a T-50, F-35, and F-16 on Jet Day.

Working as an intern in QualTech has been a very exciting experience, with a lot of freedom and flexibility regarding tasks and assignments, while also consisting of nice and friendly colleagues. It also feels like QualTech has the best opportunities for an intern to do something that leaves a lasting mark before leaving, which will be great in the future when looking back at the internship.

Unlike what some of the other interns experienced at their departments, the QualTech team seemed to be very well prepared for the arrival of new interns. An office was set up with desks, PC's, monitors, phones, a printer, and working login from the first day. While the printer and second monitors needed some work to get working, it was minor issues compared to what some of the other interns experienced. The first couple of weeks did however go a little slow without any real projects, while getting introduced to the department as well as the work done by previous interns and students. There had been developed various drone prototypes for different kinds of inspection purposes. While there were also other smaller projects during the internship, this would also go on to be the primary objective for the new Danish interns.

The initial phase was to find drone concepts to work on. The two interns each ended up with their own individual projects, where both went to build upon and improve previous concepts. One of the projects was a rolling drone that could be used to inspect runways for FOD. The initial idea was inspired by the Sphero toy, which is basically a remote controlled rolling ball. The reason for the enclosed design was to limit the possibility of the drone creating additional FOD.

Figure 7: Sphero SPRK+ remote controlled rolling ball toy. (https://store.sphero.com/products/sprk-plus)

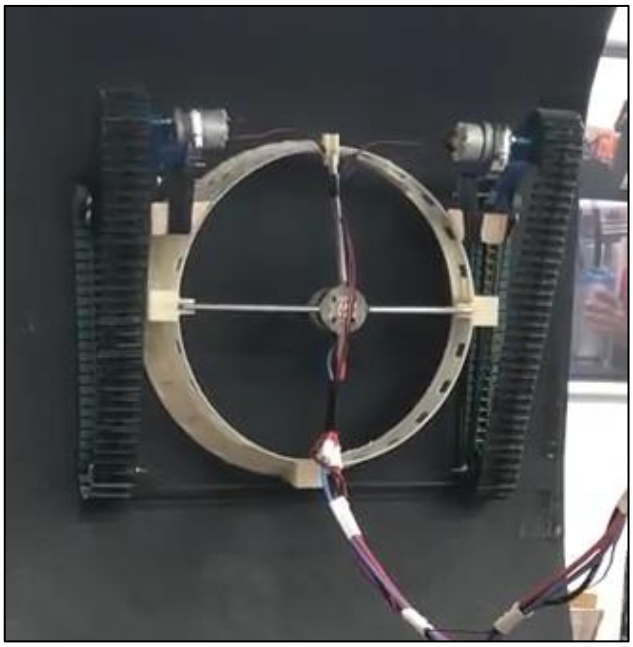

Figure 6: Initial wall climbing drone prototype for aircraft inspection made by students from an American university.

The other concept, which the author has been working on is a wall climbing drone, also called the Crawler, which can be used for inspection of aircraft. This was based on a prototype made by students from an American university in collaboration with QualTech.

There were some initial delays before really being able to work on the drone prototypes. Some software had to be installed on the PC's and training in the CAD software CATIA V5 was needed. Having never used Arduinos before, there was also some self-studying to do, which was also very interesting. To help the interns with the prototype development, QualTech had bought its own 3D printer in the beginning of the internship and are even looking to buy additional printers for the future. There was also access to 3D printers in the Innovation Garage in the plant, which is an area where Lockheed Martin employees can go to play with 3D printers and electronics in their own time. Even with the necessary training it was however not possible for foreigners to get access to the garage. As such it required escort from a colleague. Necessary tools, electronics, and other items for the prototype development were ordered by the project supervisor. Some items could take a very long time to receive, while certain items would just never show up. The QualTech team thus did what it could to help the interns create their prototypes, with only very few restrictions, like not spending unnecessary money and it being relevant for the team.

While the first Crawler managed to go both vertically and up-side down, it was tethered, heavy, and very big, with a footprint of approximately 450 x 300 mm. This made it very impractical. The primary focus of the new design was thus to create something smaller and lighter, as well as making it battery powered and remote controlled. Two new Crawler prototypes were created during the internship. The first focused mostly on the mechanical part of the drone. It was a shrunken version of the initial Crawler concept, being about a quarter of the size. It also removed the tether by using a battery as the power source and Bluetooth for remote control. This prototype saw very great success. It was tested on a C-130 and an F-16, where it proved its ability to crawl the surfaces of the aircrafts, including vertically and up-side down orientations, as well doing transitions between surfaces. Being allowed to try a homemade drone on an F-16 was a really enjoyable experience. This prototype caught a lot of attention from various groups in the organization, where it seems like there is a big desire to push for further development of the idea. Following the positive feedback and success, it seemed natural to continue developing the Crawler during the rest of the internship. The other prototype builds upon the previous design and has greater focus on electronics. It adds various sensors, a Raspberry Pi,

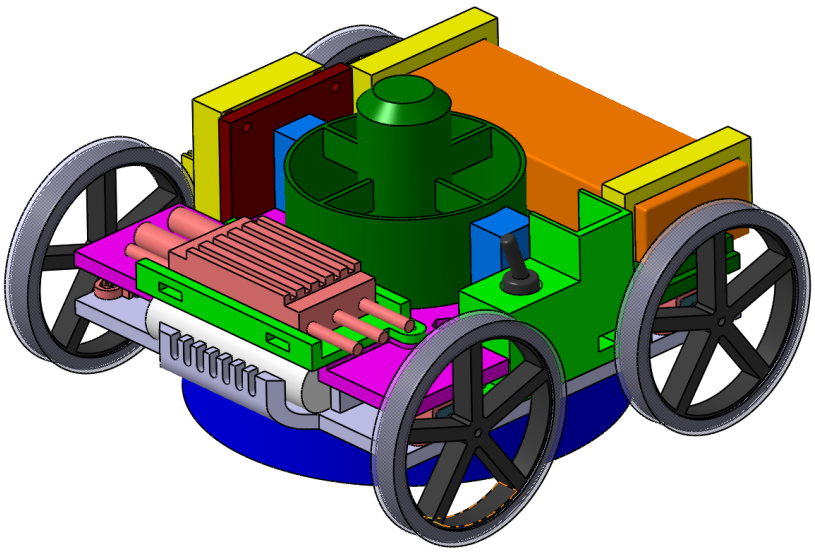

Figure 8: CAD model of the second Crawler prototype with approximately a quarter of the original footprint, and inclusion of battery power and Bluetooth control.

and a camera. The idea was to create a platform that would allow development of smarter controls, wireless video feeds, as well as machine vision. The design was completed and the prototype was also assembled. Time restrictions at the end of the internship however meant that there is still a lot of coding that has to be done in order to utilize all the newly added hardware.

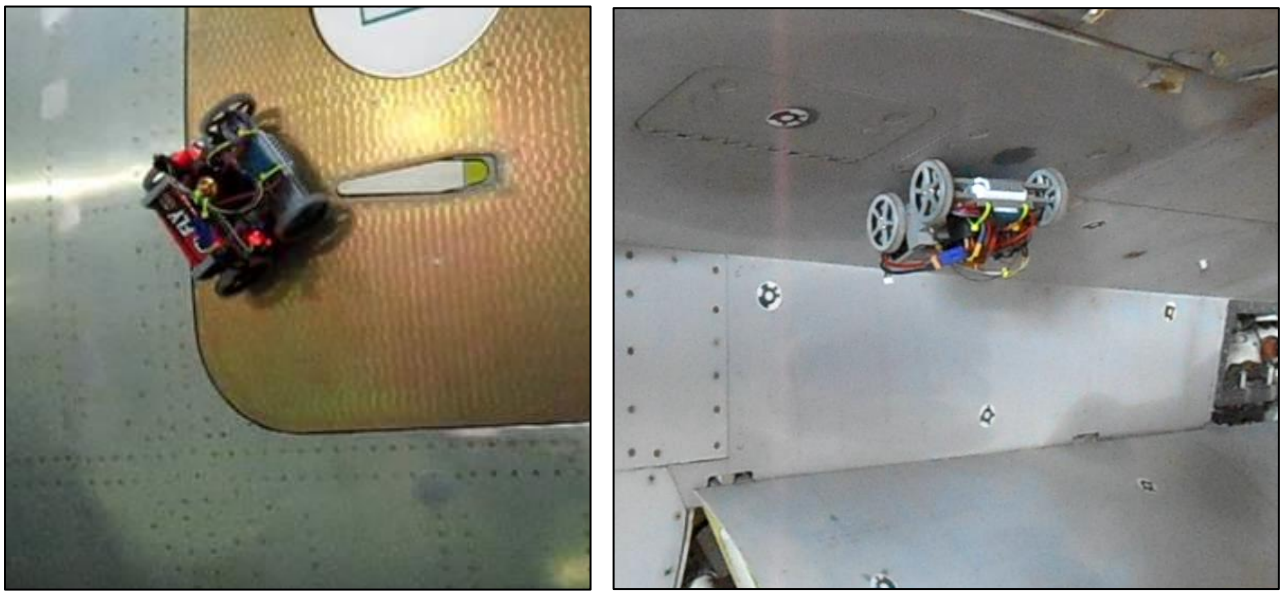

Figure 9: The second Crawler prototype during testing on a C-130 fuselage (left) and on the underside of an F-16 wing (right).

Because of all the attention the Crawler concept has received in the recent months, especially from Vice Presidents, it is expected that someone else will be continuing the work on the Crawler, for example the new Dutch interns arriving in July.

As a mechanical engineer, this internship seems to have been of great relevance doing product design and development. The Crawler development has for example included mechanical design and 3D drawing with CAD software, rapid prototyping, programming, electronics, control theory, and documentation. Many different mechanical engineering related topics can be derived from the Crawler project in the future. This could for example be optimizing the fan design for higher and more efficient thrust, reducing weight by optimizing the chassis, adding articulation and/or suspension to the wheels, adding Ackermann steering allowing the wheels to turn like on a car, or adding more advanced controllers.

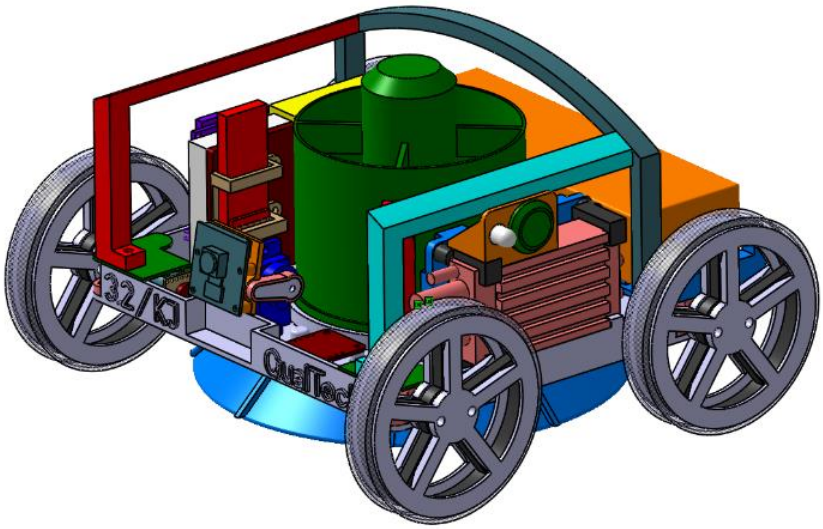

Figure 10: CAD model of the third Crawler prototype with greater focus on electronics, adding a Raspberry Pi, camera, and various sensors.

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4 Living in Texas

About half of the Danish interns (including the author) for this year had never been to the USA before, while the other half had been there previously as exchange students, tourists, or both. Common for the interns however was that none of them had been in Texas for any significant amount of time, other than driving through the state for a road trip. This meant there was a lot to explore and experience for everyone.

4.1 Daily Life

Living in Texas for almost six months was a complete change in lifestyle compared to the usual daily life in Denmark. In Denmark it is possible for most people, at least in the rural parts of the country, to live without any kind of motorized vehicle. There are dedicated bicycle lanes and sidewalks in all cities and public transportation is widespread and includes busses, different kind of trains, metros, and light rails. In Texas a car is needed to get anywhere and people usually drive even if the destination is right across the street. It is a huge state so there is often far between anything, but even staying within in the same city a car is usually required. There is only a limited amount of sidewalks and it is often difficult and time consuming just to cross a road. Bicycle lanes do exist in some cities, but they are usually just small lanes marked on the normal roads next to the car lanes. It is generally very unusual to see bicycles in Fort Worth, except on the trails along the Trinity River. Public busses do exist, but they seem very infrequent and it is rare to see people use them. Cars are however cheap to buy and own, especially compared to Denmark. There is usually also plenty of free huge parking spots available most places to accommodate people's trucks. If a car is unavailable, or if the destination is the airport or a nearby bar or brewery, the best choice is to use Uber or Lyft. Both work well with short waiting times and fair prices.

Some of the interns did cook their own food most of the time, others lived of frozen food, while some went on a mission to try as many different restaurants as possible. At the time of writing, around 130 unique restaurants have been visited by the author, mostly in Fort Worth. After almost six months the kitchen in the author's apartments has thus only been used to cook food two times, both because of visiting guests. It is generally cheap to eat out with a huge variety available, costing about 10-15$ at typical places for a full meal with drink including tip. Even after more than a 100 different restaurants in the Fort Worth area, it is still surprisingly easy to find new places to eat. The apartments also have access to grills by the pool. Later in the spring when the sun stays up a little longer, it can be very nice and relaxing to go buy some steaks to put on grill and eat by the pool.

Figure 11: Contents of the refrigerator in one of the intern apartments, which would rarely contain food.

Figure 12: Steaks are generally much cheaper than in Denmark and sometimes it is even possible to get some incredible deals like 60 quality steaks for just 180$.

Unlike Denmark and most of northern Europe, the weather in Fort Worth has generally been very good. Only rarely would the sun not be shining and the number of rainy days during the internship could most likely be counted on just two hands. The cold weather, especially in the mornings of the first couple of months from January to April where it was almost freezing, did however catch the interns by surprise, with a lack of appropriate clothing. Later in the spring months the weather got much hotter and also at times very humid, making some days uncomfortable outside. The humidity does seem to go away nearing the summer months, but the temperature keeps going up so that it can get incredibly hot outside.

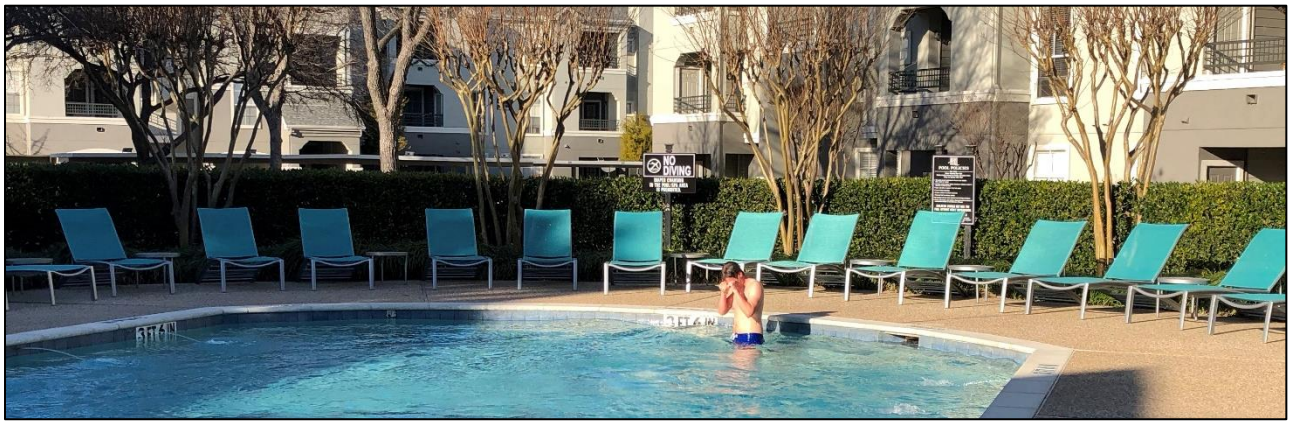

Figure 13: The first intern to jump in the pool at the apartments in late January when the water was still very cold.

The intern apartments were located very well in one of the nicer parts of Fort Worth, close to the Texas Christian University, various grocery stores, restaurants, and only 10 minutes from work by car. Most of the bars and clubs are located at West 7th Street and West Magnolia Avenue also not too far from the apartments, taking about 10 minutes with an Uber and costing around 10-15$. With almost constant intake of food, snacks, and soda, combined with driving everywhere by car, it is also wise with some physical exercise. The apartments has a pool area that can be used for some light swimming, and later in spring a volleyball net is placed in the middle of the pool to play with. A

small fitness room is also available, with a few machines and dumbbells. It is quite limited in selection, but is sufficient for some light workout. The most popular way to get exercise has been running on the trails along the Trinity River. The apartment complex has a gate leading directly to the trails, which leads around the Fort Worth area.

People in the USA have been very friendly, especially in Texas. They like to do a lot of small talk even with strangers, which is unlike most of Europe. They always get very interested when someone mentions they are from a foreign country, especially when mentioning Denmark which a lot of Texans does not seem to know about.

4.2 Trips and Experiences

Being the author's first time to the USA, there was a lot to experience. As the normal weekdays mostly consisted of very long work days of around 11 hours a day trying to save up hours, there was usually not enough time for many other activities during weekdays. This meant that when weekends finally arrived, people usually had something planned. Especially weekends with the Friday off, which were often spent on longer trips. When traveling home in the end of June, the author will have been to three air shows, five National Parks, five states, and driven countless of miles on the American roads. Below is a short summary of the different trips and experiences that the author has done off-work during the almost six months in the USA.

4.2.1 Texas

If you ask anyone what they know about Texas, they will usually mention cowboys, guns, big trucks, and meat. While all of these things seem to be popular in Texas, there was also much else to offer. One thing that must be experienced in Texas is the rodeo. The rodeo runs every weekend at the Stockyards in Fort Worth. Around end of January to start of February a larger rodeo events also takes place in Fort Worth, which can really be recommended. It is a huge indoor show with lots of

Figure 14 The opening ceremony of the rodeo was as patriotic as any American sports event, including a prayer, national anthem, and even a jet flyover, although on screens instead of real aircraft as it was inside.

different disciplines like bull riding, barrel racing, and calf roping. Outside the rodeo there is also a small carnival with various kinds of foods and drinks, including fried jalapeños and Oreos as well as various small amusement rides.

One of the first trips out of town the interns went on was to the Dinosaur Valley State Park, around an hour southwest of Fort Worth. The weather was perfect especially considering it was in the middle of January. The park has some nice trails along a river and up a small mountain, which is good for some light hiking or mountain biking. There should also be dinosaur tracks to be found in the park.

Figure 15: Seven of the eight Danish interns doing some light hiking in Dinosaur Valley State Park, Texas, in search of dinosaur tracks.

For the car enthusiast there is a huge car gathering called *Cars and Coffee* taking place the first Saturday of every month north of Dallas if the weather allows. Coming from such a car hostile country as Denmark with 150% registration fee on new cars, it is really nice to see so many interesting cars and motorcycles in one place. This includes all kinds of Ferraris, McLarens, Lamborghinis, as well as modified cars. They will even run the cars on nearby roads. The roads are however public and in use, which means a lot of police chases can also be witnessed, when the cars try to escape onto the nearby highway.

Figure 16: A first generation Ford GT is among the kind of cars that can be seen at Cars and Coffee.

At Texas Motor Speedway just north of Fort Worth various racing events take place, including NASCAR and IndyCar. At a capacity of 180.000 people, it can really bring in a huge crowd. While watching all 334 laps of a NASCAR race can get boring in the end, especially if the weather is cold and cloudy, it is still a very American thing that should be experienced. Just remember to bring earplugs and sunscreen, even if it is overcast.

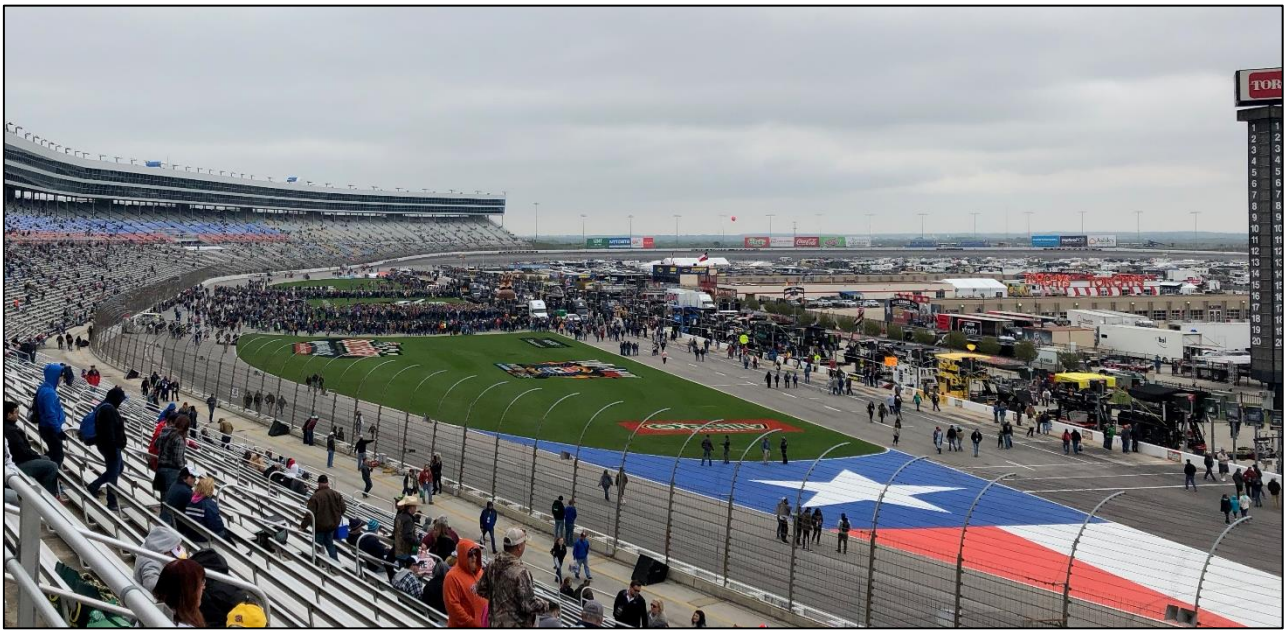

Figure 17: Interior of Texas Motor Speedway on a rare overcast day in preparation for the NASCAR race start.

Figure 18: Shooting riffles at a shooting range is a good way to relieve stress.

Of course coming from northern Europe with strict gun laws, going to a shooting range is also a must try. There are various shooting ranges in Fort Worth, both indoor and outdoor. It can be expensive to go there alone, because of the gun and lane rental, as well as buying ammunition. Being new to shooting riffles, it was perfect for three persons to share a riffle on a single lane. Trying to aim a riffle precisely can be tiresome for the arms, so a short break to rest the arms once in a while is welcome.

About a four hour drive to the south lies Austin, the capital of Texas. The city feels much different than the rest of Texas, housing many young people. In March the annual film and music festival South by Southwest takes place in Austin.

Even further south by the coast of the Mexican Gulf around eight hours from Fort Worth, lies Corpus Christi. Coming from Denmark where there is never more than around 45 minutes to the nearest coast, it is easy to miss the sea when staying in Fort Worth. In Corpus Christi there is a lot of beaches and nice blue water to enjoy, especially on Padre Island. It is recommended to go there during Spring

Figure 19: Three of the interns standing on a closed road in front of the Texas State Capitol, Austin.

Break, as it should be full of college students by then. There is also an old aircraft carrier, the USS Lexington build during the World War II. It is possible to walk on the many decks of the carrier, which houses different kinds of exhibitions, an IMAX, as well as various aircrafts on its flight deck.

Figure 20: The WWII aircraft carrier USS Lexington, Corpus Christi, Texas has a lot to offer including aircrafts on its flight deck.

If traveling to Corpus Christi it can also be recommended to stop by San Antonio, which has the site where the Battle of Alamo took place in the early 19th century, as well as the Nautral Bridge Caverns. Also close to the Mexican Gulf is Houston, about five hours southeast of Fort Worth. It is strongly recommended to go there for the Johnson Space Center, with the guided Level 9 Tour, even though it costs almost 200$ per person. The tour takes a couple of hours and goes through various buildings at the site, including a Saturn V rocket and both the current Mission Control Center, and the older one as known from the moon landing. Like Corpus Christi it is also possible to relax by the beach or get some fresh seafood, by travling around 45 minutes to Galveston southeast of Houston. The water does however not look as nice as in Corpus Christi.

Figure 21: The Mission Control Center at the Johnson Space Center, Houston.

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It was also possible to attend dragracing, including Top Fuel Dragsters in Houston, which was a really loud and special experience. There was even Top Fuel Harley Davidson motorcycles running against each other as well, which seemed slightly dangerous.

Figure 22: Top Fuel dragsters about to start the 1000ft drag race at Houston Raceway.

The Danish interns were invited by a Danish pilot instructor to Sheppard Air Force Base in Wichita Falls, northwest of Fort Worth. The base serves as a training facility for pilots from all over Europe, including Denmark. It was fun to be shown around the base and get a lot of time in simulators, try a g-suit and helmet, as well as talk to the Danish pilot trainees. It was also on the same evening as one of the Drop Night, which is like a graduation event where the pilots find out which aircraft they will be assigned to. It is a very big event for the pilots, where some might be assigned to F-22's or F-35's for their future career, while others get something like a C-130.

Figure 23: Danish interns in front of a T-38 jet trainer at Sheppard Air Force Base, Texas.

Figure 24: Trying on the pilot helmet, which turns out to be difficult to breathe through.

4.2.2 National Parks

The USA is known for its many popular national parks, which are located all across the country. So far the author has gone to four different national parks during the internship, including Big Bend, Zion, Grand Canyon, and Yosemite. A trip through Death Valley is also planned for after the

internship ends in June, where the temperatures should be very extreme. The national parks usually have some incredible sights and nature. From the tall trees and numerous waterfalls in Yosemite, to the deep valleys and steep trails of Grand Canyon, there is a lot of variety to experience. There is usually a lot to see from the seat of a car, but to get the full experience it is almost necessary to go hiking on some of the many trails that are located in the parks. It is also usually possible to camp in the parks, which however often requires a permit that should be ordered beforehand.

Figure 25: The roads near Big Bend National Park can also present some beautiful sceneries.

Big Bend National Park is located in the far west of Texas, bordering Mexico. The park is named after a large bend in the river Rio Grande, which serves as a border between Texas and Mexico. It is thus possible to pass into Mexico by crossing the river, which in places can be done without getting into deep water. This is however not recommended, as it can represent various problems if caught by a patrol on either side. The park consists mostly of open desert areas, as well as mountains and vertical cliffs. It is also known to have one of the darkest skies in the USA, meaning that it is possible to see some incredible night skies full of stars. The park is very dry and can get very hot. It was however surprisingly comfortable in late January. Even though it is located in Texas, it is around an eight hour road trip from Fort Worth. So even with Friday off, it can be difficult to have enough time to experience the park in a weekend.

Figure 26: Santa Elena Canyon Trail should be experienced if vising the Big Bend National Park.

Zion National Park lies in the south-western part of Utah. The park has some beautiful sceneries, especially in the Zion Canyon. The park contains plenty of trails of various distances and also a lot of possibilities for rock climbing. Especially the Angels Landing Trail can be recommended, which is approximately 4 km long with about 500 m of elevation gain. The last part of the trail is very steep and narrow, with sharp drop

offs. The top of the Angels Landing provides a very good view of the Zion Canyon. If traveling to Zion, the best option is likely to fly to Vegas. From there it is only around 2-3 hours of driving to the park entrance. Zion is also only about a 2 hour drive from the North Rim of Grand Canyon or about 5 hours from the South Rim.

Figure 27: View from top of the Angels Landing in Zion National Park.

Grand Canyon National Park is probably one the best known National Parks in the USA. Going there for the first time can really be a striking sight. The canyon is huge, both wide and deep. Pictures really cannot give a realistic impression of what it is like to see in person. It is recommended to go to the South Rim of the Grand Canyon. The fastest way is likely flying to Phoenix, Arizona.

Figure 29: View of the Grand Canyon at the top of the South Rim (left) and at the bottom of the canyon (right) showing one of the bridges over the Colorado River.

Figure 28: One of the Danish interns recovering by eating Skittles after finally getting back up after the approximately 24 km, 6 hour hike to the bottom of the Grand Canyon and up again.

While a lot of nice sceneries can be seen from the top, going down the canyon from one of the many trails should also be experienced. For the persons seeking a more extreme hike, some of the trails go all the way down to the Colorado River at the bottom. It is however often pointed out that it is not recommended to go down the bottom and up again in a single day. The Danish interns, which are mostly not in very good shapes, went on the South Kaibab

Trail, which is around 12 km each way to the bottom and up, and with elevation change of almost 1.500 m. It took about two hours to reach the bottom, while taking around four hours of sweat and pain to get back up again. Remember to bring a lot of water and sunscreen. While it only required around half a liter of water to get down, each intern carried about three liters on the up, which was barely enough. While there is water at the top and bottom, there is no water on the trail itself so be cautious. Because of the many breaks that are likely required on the way up, there is plenty of time to enjoy the beautiful views, which are also accompanied by almost complete silence. It was really one of the more significant experiences in life.

Yosemite National Park in California is also one of the well-known parks in the USA. It is best known for its giant trees, granite cliffs, and numerous closely located water falls in the Yosemite Valley. The park is very big and has around 1.300 km of trails. If only going there for a one or two days it is likely best to head for the Yosemite Valley where many popular trails and waterfalls are located. If going there for the waterfalls, it should also be kept in mind that the waterfalls usually stop flowing in late spring or start of summer. If traveling to the Valley by car, be prepared to get there early as it can be very difficult to find a parking spot during the day. The park is around three hours from San Francisco by car.

Figure 30: View of Yosemite Valley with Bridalviel Fall in the background.

Figure 31: While the water spraying from the waterfalls can provide a lot of highly visible rainbows, it also means there is a good chance of getting very soaked while hiking on the trails.

4.2.3 Washington, D.C.

The capital of the USA has a lot of different attractions and landmarks like the White House, Pentagon, monuments, countless free museums, and the Arlington National Cemetery. Most of the places can even be reached by foot, such that a car is not required. It is also only about a three hour flight from Fort Worth. Perfect for a weekend trip with a Friday off.

Figure 33: The Vietnam Veterans Memorial with the Washington Monument in the background, Washington, D.C.

Figure 32: A SR-71 and the Discovery Space Shuttle in the background at the Smithsonian National Air and Space Museum at Washington Dulles International Airport, Virginia

4.2.4 California

California is also only about a three hour flight from Fort Worth. Other than Yosemite the state itself has some very nice scenery when driving on the public roads. There is both mountainous as well as completely flat terrain, with forests, deserts, and coasts. The climate also varies greatly depending on location. Of course California also has some well-known cities like Los Angeles, San Francisco, and San Diego. After having lived in Texas for a while, going to California presents a much different view on the American culture.

Figure 34: The Golden Gate Bridge in San Francisco on a cold cloudy day.

4.2.5 Air shows

While some aircrafts can be seen taking off and landing at the plant in Fort Worth, seeing various aircrafts perform at an air show is just something else. The Danish interns have managed to go to three different air shows. Yuma Air Show in Yuma and Luke Air Show near Phoenix, both in Arizona and during the same weekend. The third air show was at Dyess Air Force Base near Abeline in Texas, just west of Fort Worth.

The interns got to see a lot of different aircrafts both old and new, on static display and in the air. This for example includes the C-5, C-130, V-22, F-16, F-18, A-10, B-1, B-52 and even the F-22 and B-2. There was even helicopters like the UH-1 Huey, and AH-1 Cobra. Of course there was also the F-35, where it was nice to finally see it in some more serious action. There was even displays of the F-35B doing short takeoffs and stopping mid-air to hover. Various acrobatics aircraft also performed, which was really impressive.

It can thus be highly recommended to keep an eye out for upcoming air shows. Just remember to bring lots of sunscreen and possibly also earplugs.

Figure 35: A rare opportunity to get up close with the F-22 at Luke Air Show near Phoenix (top left), a very rare sight of the B-2 stealth bomber as it performed a fly-over at the Dyess Air Show in Abeline (top right), an F-22, F-35, A-10, and P-51 in formation at Luke Air Show (bottom left), and a B-1 bomber ready to take off at Dyess Air Show (bottom right).

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5 Conclusion

The whole experience related to the internship at Lockheed Martin in Fort Worth, Texas has been very positive and exciting. It has likely been a once in a lifetime opportunity as a foreigner to work directly for an American military aircraft manufacturer. Working at Lockheed Martin Aeronautics has really given an insight into what it is like to work for such a large company in the defense industry, and all of the many small annoyances and restrictions that follow, especially as a foreigner. Working for the QualTech team has been a good experience, with plenty of engineering relevance, exciting work, as well as nice colleagues. The tasks have consisted of various smaller projects, but the primary project has been development of drone prototypes. It was decided to work on improving upon an existing prototype, which included working with 3D CAD software, rapid prototyping, programming, electronics, control theory, and documentation.

Outside work a lot has also been going on. Even though most of the eight interns did not know each other before getting selected for the internship, as well as all having very different personalities and backgrounds, they all managed to get along, living and travelling together with no problems.

Coming to the USA for the first time, everything was new and there were plenty of things to experience. Before heading home in the end of June, the author will have been to more than 150 unique restaurants, three air shows, five National Parks, and five states during the six months in the USA. Even then there is still a lot of things left to see for the future.

For future interns there is a lot to look forward to, and for those who have not applied yet, do not miss out on the opportunity.