MrBaddeley
R2D2 version 2 Lavigne Gripper Arm instructions
Version 0.1 (Draft)

https://www.patreon.com/user?u=4294285
for other parts and instructions

Features...

Fully printed and modular fitting to R2D2ver2, easy swap / maintenance.

Uses S3003 and SG90 standard servos

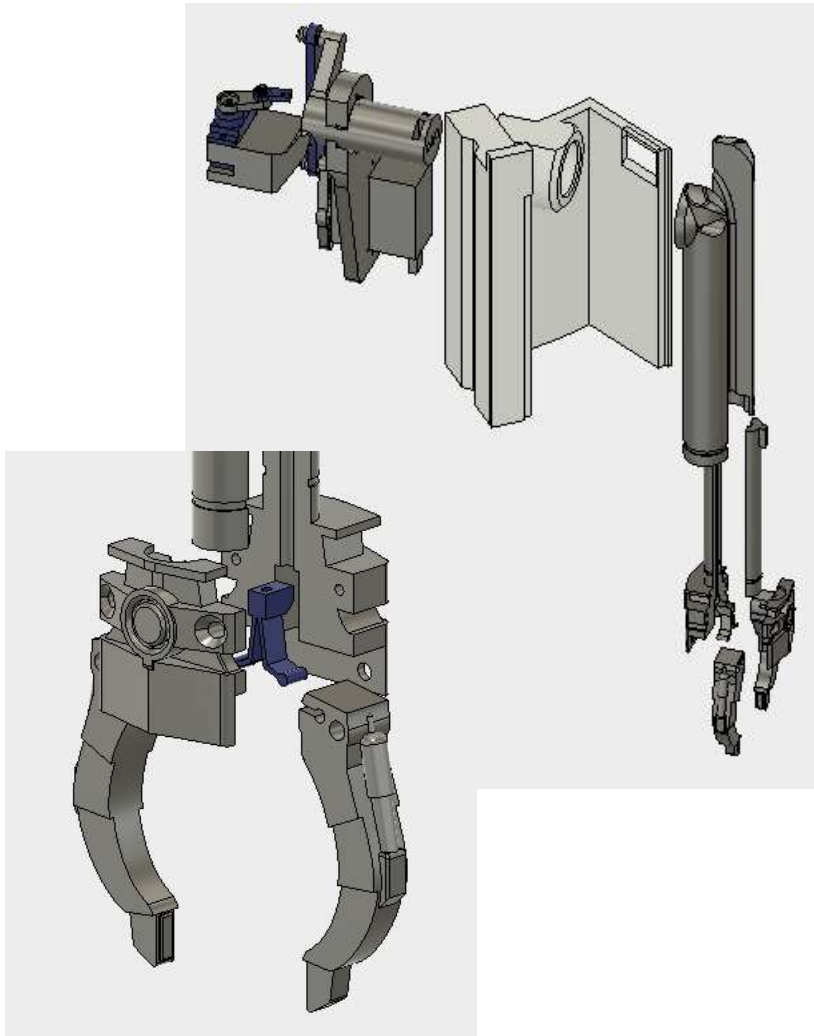Uses 1.75mm nylon filament as the drive "cable"

Designed for screen accuracy and scale.

Arm and Gripper animated, comes out and grabs.

MrBaddeley R23D printed holoprojector instructions.

Firstly the basics, all parts are printed in ABS, I used 3 outer layers on 25% infill for the most part. I did the Servo Arms with 45% infill for strength. I would recommend high resolution for external parts (.1 or .2 layer) .3 for anything you can't see. A couple of parts are printed in Ninjaflex Cheetham (I've used NinjaFlex Cheetham throughout, just not realised, I bought some NinjaFlex and it was "floppy" so Cheetham is slightly more rigid and easier to print). The Ninja Flex is for the "blue" parts shown. Basically the bar which lifts the arm, the servo connector for both ends of the filament cable. I've add "NF" to the end of the descriptions for the Ninjaflex parts. The size and simplicity of the design is down to a small Ninjaflex hinge on the grippers which attaches to the cable. Once you've got the parts, it's an easy assembly.

Hardware wise, a couple of M4 bolts (I use countersunk hex type) around 15 mm should do with some square nuts to hold the arm on. Some M3 bolts (around 9mm). Also a few small self tappers (I think I ordered 3mm or it could even be 2mm thread, around 15mm long). I would recommend grapping a few different small self tapping screws as they come in useful across the build. They're about the same size as the ones which come with the Servos.
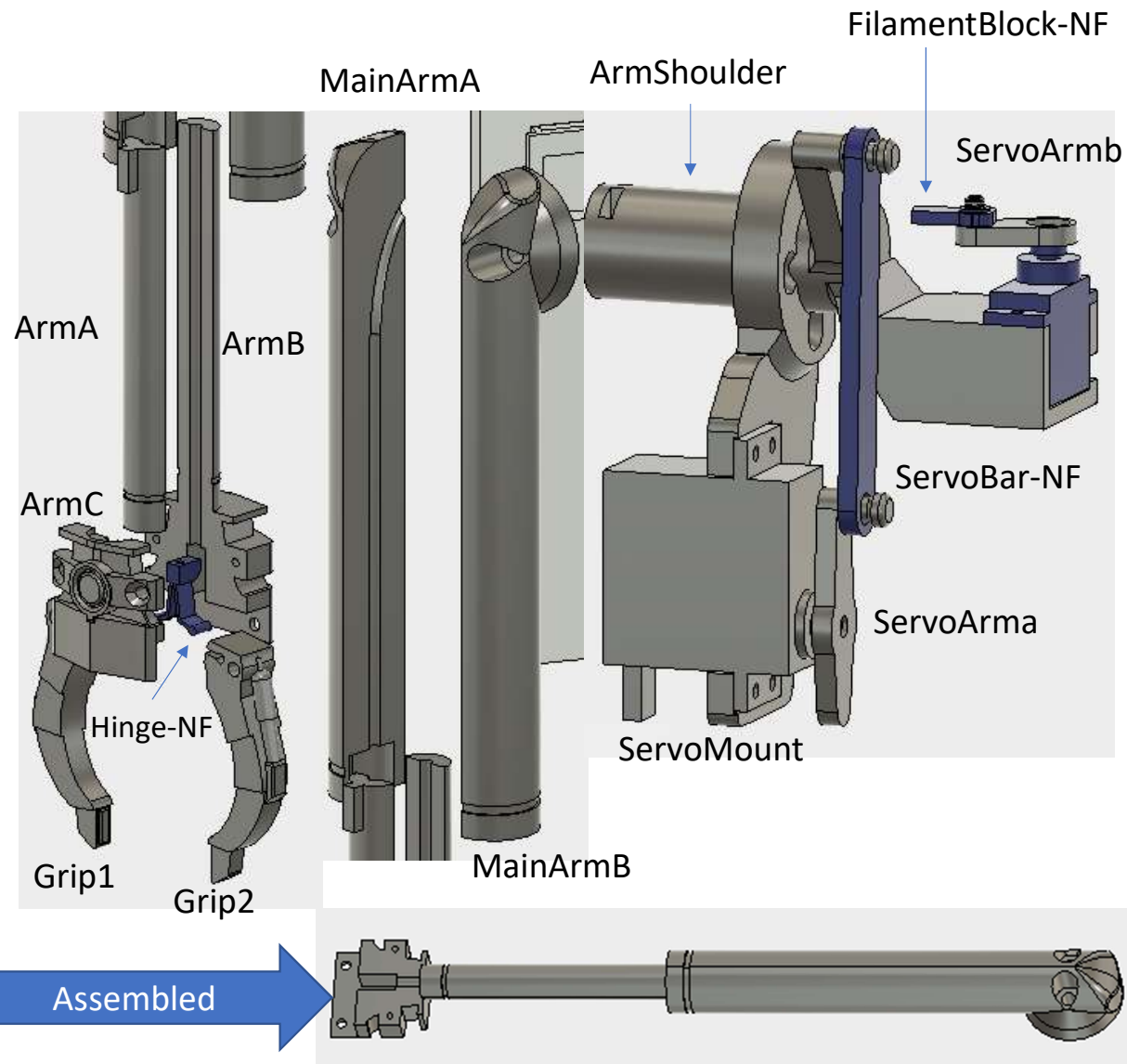
1.75mm nylon filament is also needed as the cable which runs through the arm to control the gripper. Works really well and will be doing this on the other arms.

Firstly print and familiarise yourself with the build. All parts are printed only once.

Quite a few of the parts do need support, this is always a trade off between support (ready assembled) or cutting into many parts and gluing together. The ArmShoulder is printed with the flat "circle" down and does need supports. I would recommend removing supports in the centre two M4 Screw holes as these are hard to remove once printed and not really needed.

The NinjaFlex Cheetham parts I printed at 30% infill, that's the Bar and the two ends of the control cable.

First part to assemble is the Arm, glue (I use acetone welding) MainArmA and MainArmB together. Note the cable channel and make sure it's clean before gluing and no glue or "ooze" gets into it. I would recommend having a few lengths which you can push through when gluing to check it's a smooth run. Next same process with ArmA and ArmB (leave ArmC, this only screws on.

FilamentBlock-NF

MainArmA

ArmShoulder

ServoArmb

ArmA

ArmB

ServoBar-NF

ArmC

ServoArma

Hinge-NF

ServoMount

Grip1

Grip2

MainArmB

Assembled

Assembling the arm…

Once you've glued (or welded) the main arm parts, you should have something like this. Make sure a 1.75mm length of filament (I used nylon but please experiment) moves freely through the centre channel coming out on the gripper arm and the shoulder.
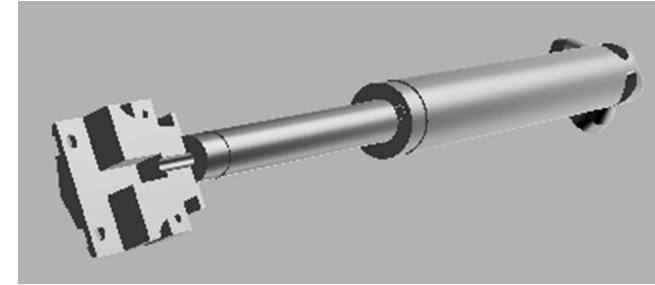
Next take two M3 bolts (9 or 10mm should do, I used hex round head ones). These screw into the Gripper frame to give the two pivots for the Grippers. Note if you put ArmC part on top, they should not touch or just touch but the ArmC should still fit flat. Once you're happy with the fit, unscrew slightly and apply a few blobs of Superglue Gel to the inner head and tighten so the crew head is glued to the frame to add extra strength. These are the two bars that the Grippers will hinge on.
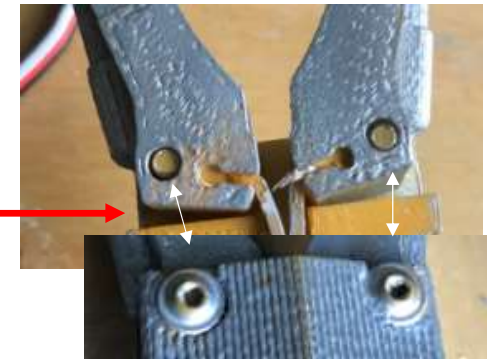
Next take the two grippers and the Hinge-NF. The Hinge-NF just pushes into the two tear shaped slots on the grippers to hold them together. The Hinge-NF can be pushed in with a small screwdriver so it's flush or slightly recessed.
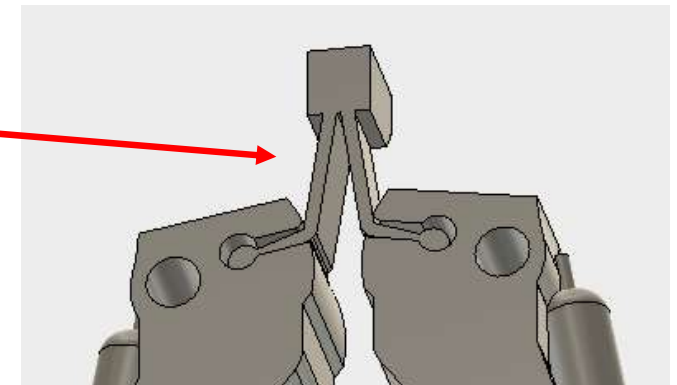
At this point I would suggest sanding, finishing and painting the arms and gripper. I did a quick finish for the photos but a good finish will make a big difference. I suggest rub n buff for the silver parts. (Typically I'd fill / sand, filler primer, black coat, aluminium spray and finish with rub n buff, then weather). Once finished you're ready to assemble.

Finishing the arm…

Now, take a length of 1.75mm Nylon Filament and pass through the arm channel. Trim the end near the Gripper and insert into the filament block. Then drop the gripper arms onto the M3 bolts (pivots).

At this point you should be able to manually open and close the grippers from the cable near the shoulder. Make sure it's free moving.

Once you're happy with the mechanism, put a small blob of superglue gel on the end of the 1.75mm Nylon Cable and glue into the filament block. (it will hold by friction but the superglue just makes it solid).

Next take the ArmC cover and using two small self tappers, screw the cover over the gripper arm to complete the arm assembly.
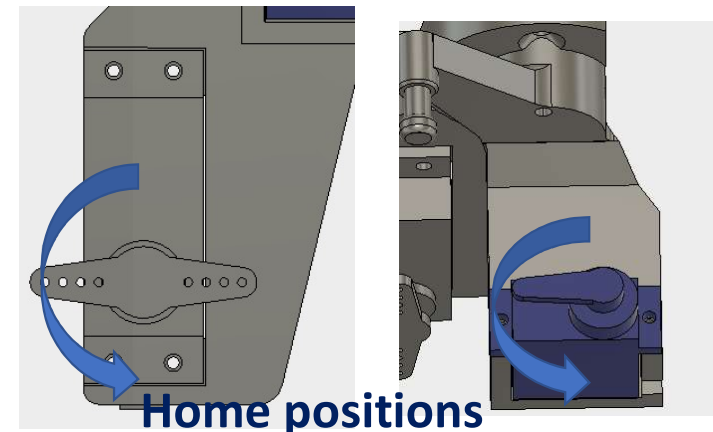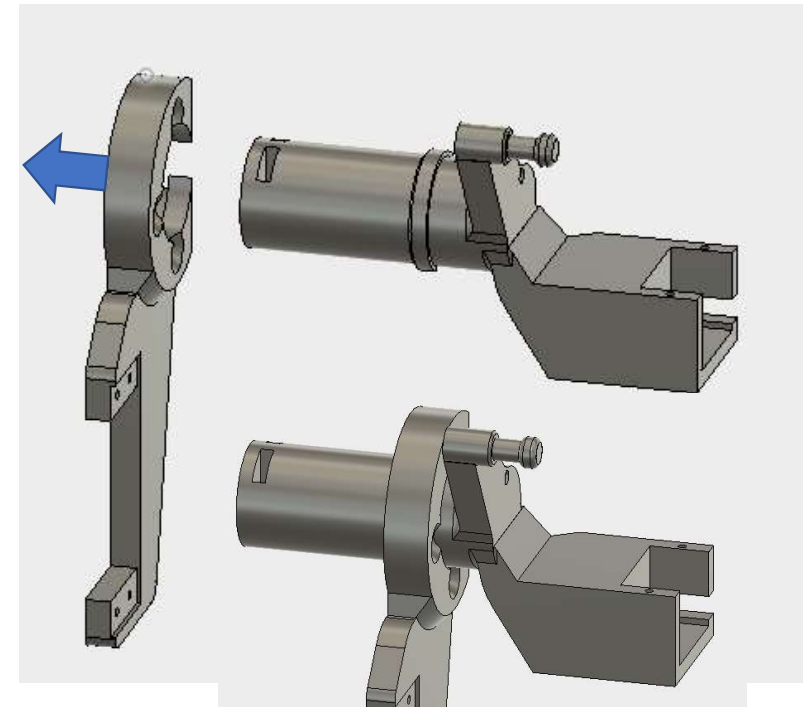
The servo bit...

Firstly assemble the shoulder and the Servo mount. These fit together as shown in the diagram. Firstly they're a tight fit and secondly you're trying to get the Servo mount past the "shoulder". This is done by rotating the shoulder (there's a cutout which matches) and then a little bit of gentle force. The Servo mount is fairly tough so don't worry too much about breaking it, just a little flex should do it. Then spin it back so it's roughly like the diagram.
Next screw the two servos into the frames. Each servo should be supplied with screws. These should fit the frame / holes and grip. Select the control arms from the servo packs as shown in the diagram.
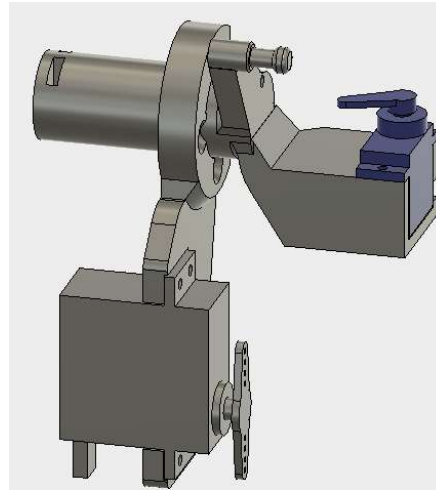
Put the control arms onto the servo and you can gently spin the servo so the position is correct. The "home" (centre) position should be as shown.

Next attach the two Servoarms over the ones supplied with the Servos and screw into place.

Home positions

The servo bit continues …

Now, push the two NinjaFlex parts onto the mechanism as shown. The Servo Bar connects the large Servo to the Shoulder mechanism and the filament block is for controlling the gripper. Drop two M4 square nuts into the two slots in the shoulder, this is where the arm will screw to when you're ready to fit the whole assembly (which is about now!).

Take this assembly to the main body, This fits into the hole in the large side panels at the top (easy to access with the dome removed). Push the mechanism into the hole fully and you'll see three screw holes for small) 2mm or 3mm self tappers, which hold the ServoMount to the main frame. You'll need to move the large servo to get access to all the holes, but gently tighten (don't over tighten, you can put some screw locktite but I didn't bother). This should securely hold the frame in with the face which has the M4 holes in, just flush (slightly protruding) the hole inside the large panels.

Next take your arm and thread the 1.75mm Nylon filament through the centre hole in the ArmShoulder until the arm is in postion. Next take 2x M4 bolts and push them into the arm holes and tighten up (again without over tightening) to secure the arm to the shoulder.

The Arm should now be securely fitted to the frame and the servo should lift and drop the arm if you gently manually move it.
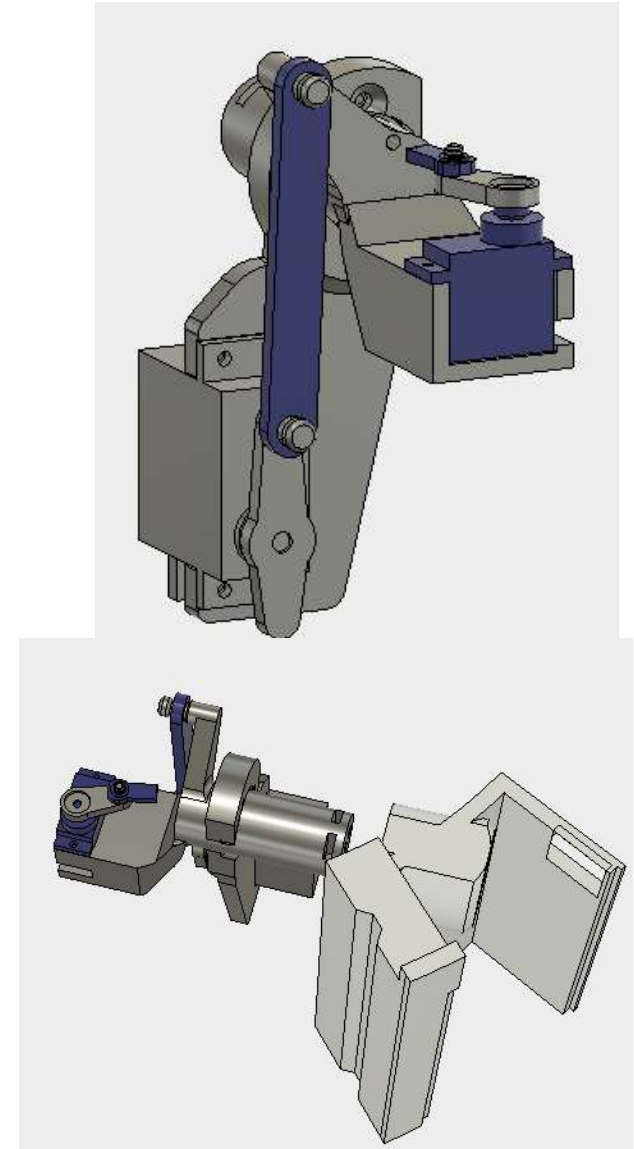
Finishing off…

So now it's simply a matter of moving the gripper servo to a comfortable "close" position (slightly back from centre), measuring the filament and cutting so it can easily fit into the filament block. Then push the filament into the filament block and test the gripper open and close mechanism. It should work freely and easily.

You can also add a small block of superglue gel to this end of the cable to fix into the filament block if you want (I didn't as I was testing it and it's easy to access).

You should now have completely fitted your gripper arm.

You'll have two servo cables inside for the two servo and these can be driven by the Adafruit 16 channel 12 bit Servo Board (or which every solution you want to try).

I'll publish a bit of my notes on the code and a sample of my Padawan 360 modifications in the Patreon share but the Adafruit is fairly easy to control from the Arduino.
Here's an extract of the code, just so we can go through how it basically works.
You set up the Adafruit board as "pwm2" (I've got 2 on my set up and you can chain loads together but "pwm2 refers to the board).
The "setPWM" command sends the signal to move, the first number is the servo number (0-15, 16 servos), ignore the "0" and the value is the position it moves to. So I set the variables at the beginning and in the code just send them as "GripperArmOut" for ease.

As I said, this is quick intro but I'll cover some of the coding mechanisms in another instruction but hopefully this will give you a start. Note if the Servo tries to go beyond it's limit you may burn it or the power supply out, so the numbers I've given work as a good starting point. 300 has been fairly safe for me to start with, but I do these things through trial and error.

```
//gripper values
int GripperOpen=270;
int GripperClose=325;

int GripperArmIn=170;
int GripperArmOut=570;
```
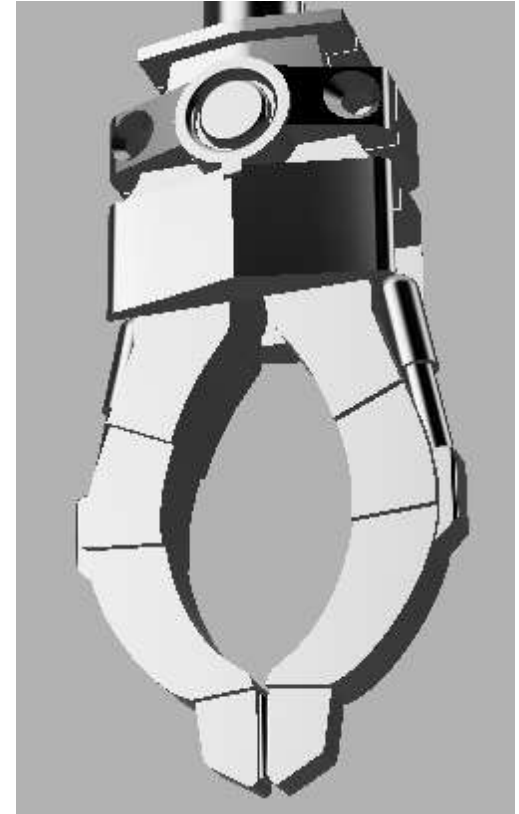
```
Pwm servo commands
//
pwm2.setPWM(2,0,GripperArmOut);
pwm2.setPWM(2,0,GripperArmIn);
pwm2.setPWM(3,0,GripperClose);
pwm2.setPWM(3,0,GripperClose);
```

Check the Adafruit website for tutorials and set up. It's actually fairly easy.
Recommend a chunky 5v power supply though. I use a DROK 15 amp DC – 5vDC convertor.

Supported and tested by Sean Lavigne, Jay Williams, Steven Elford, Robert Gusek, Rob Dinniwell, Joseph Masci, Sam D. Fenimore, LarryJ, tevans, Rick Davis, Brendan Faulkner, Nicolas Carré, Ben Langley, Mathieu Saint-marc, Chistopher Edwards, Mark Oram, Tim Parr, Jon Haag, John Gardener, Ryan Roehitch, Oiva Ranta, Wes Thierry, Robert Bean, Mitchell Young, Jake Danible, Simon Ruel, William Meyer, Brian Bishop, Danny Olsson, Rob Saey, Steve Nuitall, Gregory Welch, Ben W Bell, Tarak Sallini, James Van Dusen and Brian.