

# Design of Electrical Joints for Underwater Manipulator

**Graduand:** Thomas Schmidhäusler

**Examiners:** Dr. Gerald Seet (NTU), Prof. Jürg Meier (HSR)

## Task

The Robotics Research Centre of NTU has conceptualized a seven degrees-of-freedom robotic manipulator for underwater inspection of weld seams. Five rotary electrical joints are to be designed as part of this larger project. All joints need to be waterproof and fulfil the specific performance requirements.

The design incorporates seals to exclude the ingress of water and bearings to decouple the external loads from the actuators.



## The Manipulator

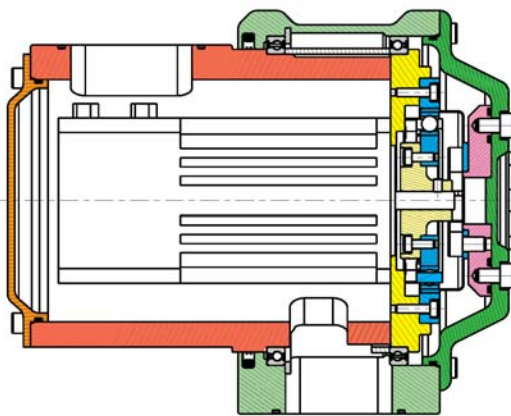
Offering five degrees of freedom, the manipulator consists of five rotary joints. Strong connection between the joints is ensured by carbon fibre links. Power supply and controlling is provided through a bus system, completely guided on the inside of the manipulator. Despite its very low weight, the manipulator is powerful enough to operate even in atmospheric environment.

## Joints

The lightweight joints combine compact design and high torque capabilities. Smart arrangement of the components allows to get maximum rigidity.

The motor -mounted in a casing- actuates a Harmonic Drive Gear whose output side is attached to the next stage of the manipulator.

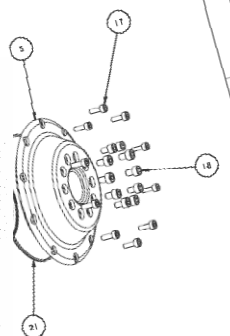
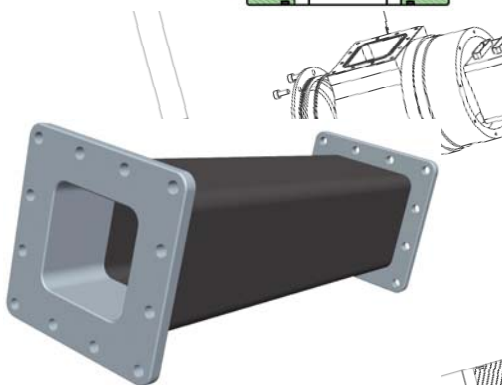
Corrosion resistance is assured due to application of anodized marine aluminium alloy.



## Links

To get maximum stiffness and rigidity at very low weight, the connecting links are made of carbon fibre composite.

The linkage concept offers modular design, enabling to install different lengths and the ability to turn rotational axes for custom agitation layout.



QUANTITY	PART NAME	DESCRIPTION
1	CI BELT	135mm
1	CE-ES-160	CE-ES-160
1	JA CONNECTION	JA CONNECTION
1	JA COUPLER	JA COUPLER
1	JA MOTOR COVER	JA MOTOR COVER
1	JA MOTOR FLANGE	JA MOTOR FLANGE
1	JA MOTOR FLANGE	JA MOTOR FLANGE
1	JA MOTOR FLANGE	JA MOTOR FLANGE
1	JA MOTOR FLANGE	JA MOTOR FLANGE
1	JA MOTOR FLANGE	JA MOTOR FLANGE
1	JA MOTOR FLANGE	JA MOTOR FLANGE
1	JA MOTOR FLANGE	JA MOTOR FLANGE
1	JA MOTOR FLANGE	JA MOTOR FLANGE
1	JA MOTOR FLANGE	JA MOTOR FLANGE
1	JA MOTOR FLANGE	JA MOTOR FLANGE
1	JA MOTOR FLANGE	JA MOTOR FLANGE
1	JA MOTOR FLANGE	JA MOTOR FLANGE
1	JA MOTOR FLANGE	JA MOTOR FLANGE
1	JA MOTOR FLANGE	JA MOTOR FLANGE
1	JA MOTOR FLANGE	JA MOTOR FLANGE
1	JA MOTOR FLANGE	JA MOTOR FLANGE
1	JA MOTOR FLANGE	JA MOTOR FLANGE
1	JA MOTOR FLANGE	JA MOTOR FLANGE
1	JA MOTOR FLANGE	JA MOTOR FLANGE