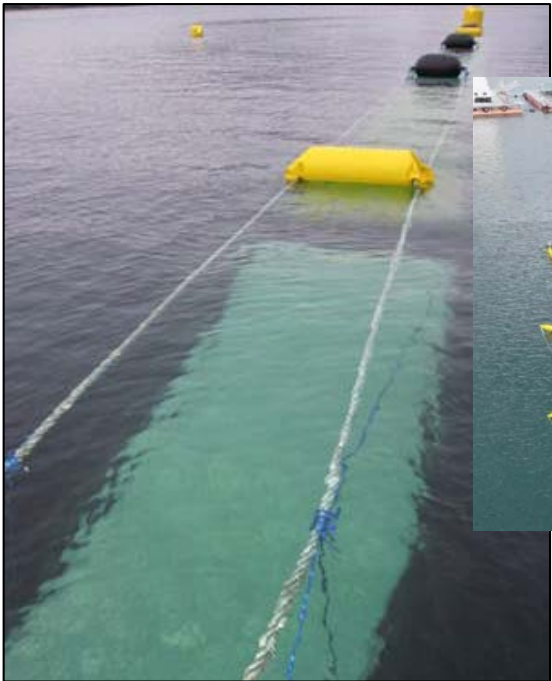
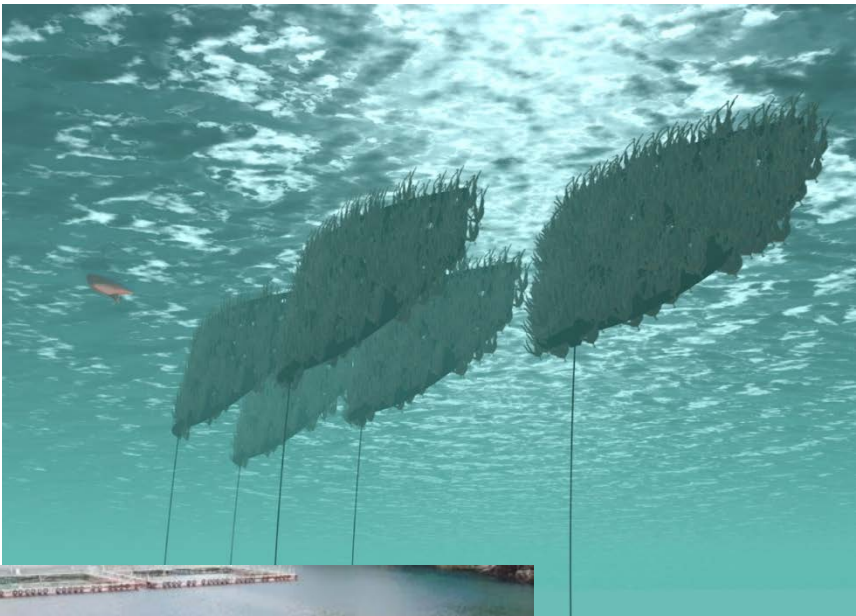
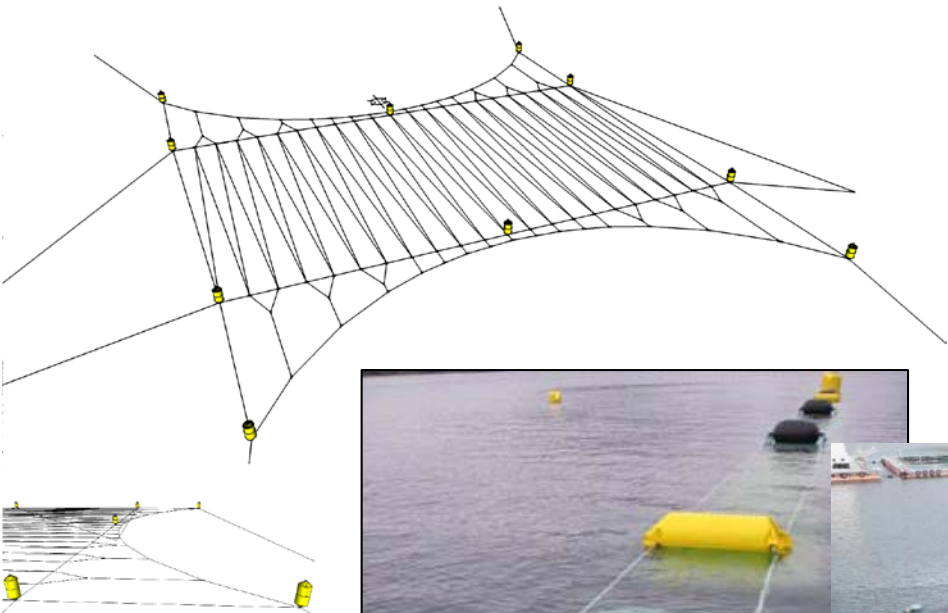


Automation of cultivation technology

Torfinn Solvang

State of the art

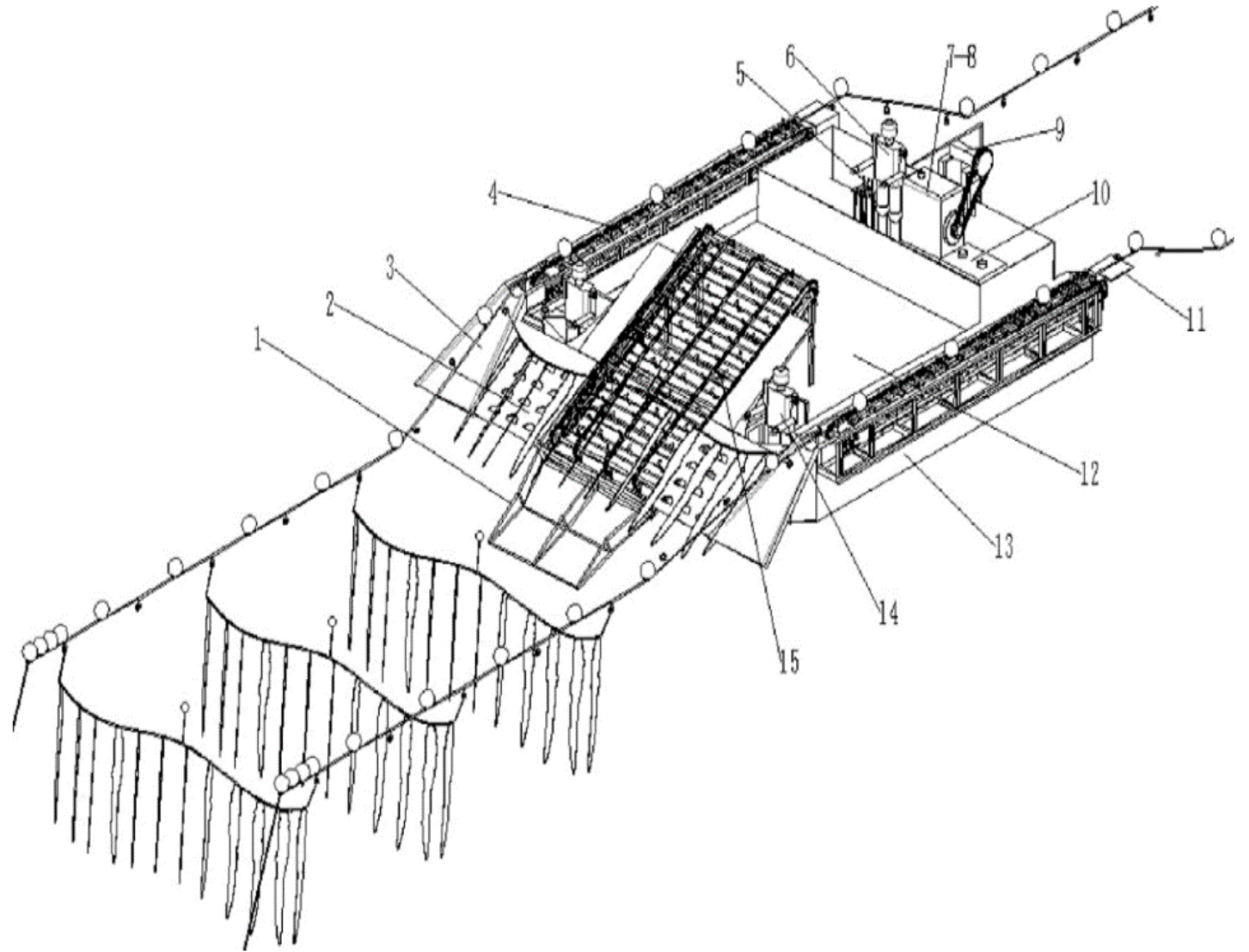


- Farm designs
- Methods for seeding
- Methods for harvesting

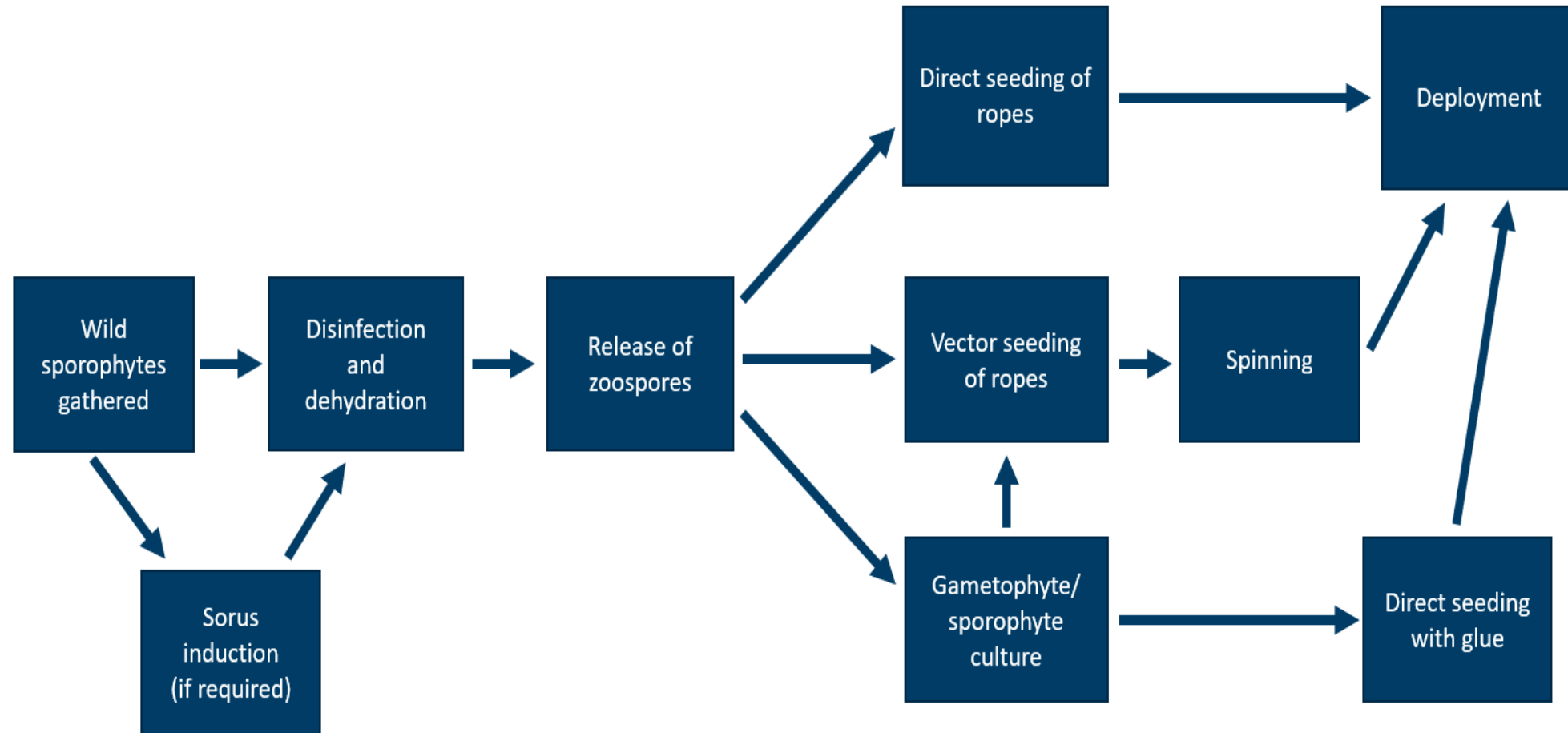
State of the art

China: Mechanized harvesting raft

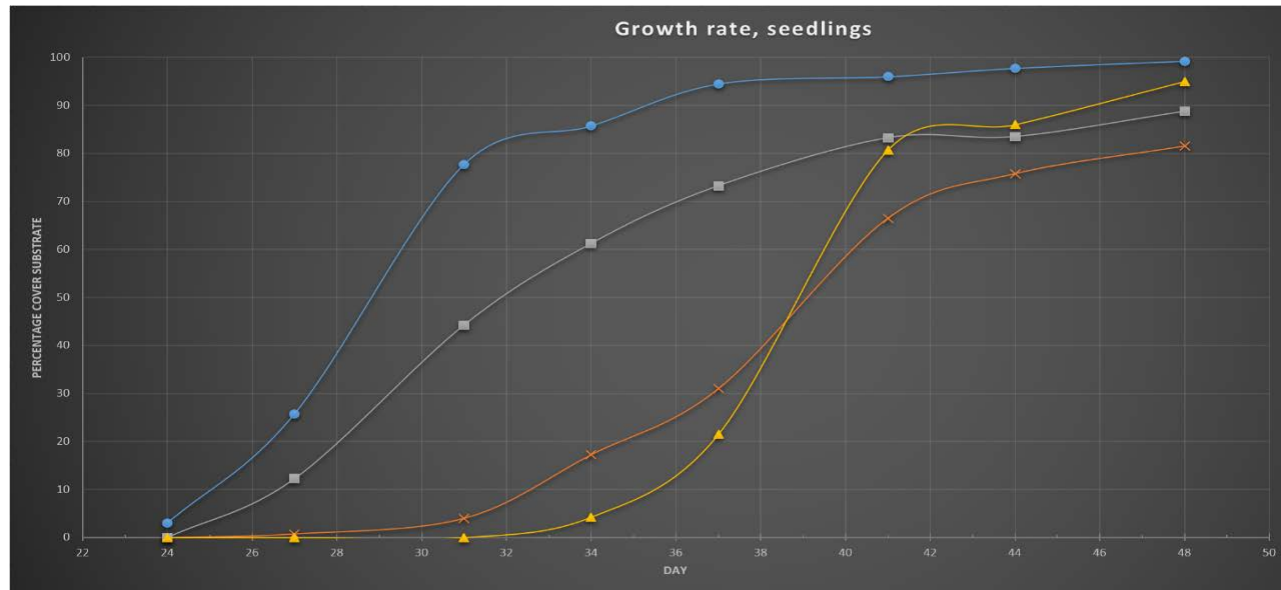
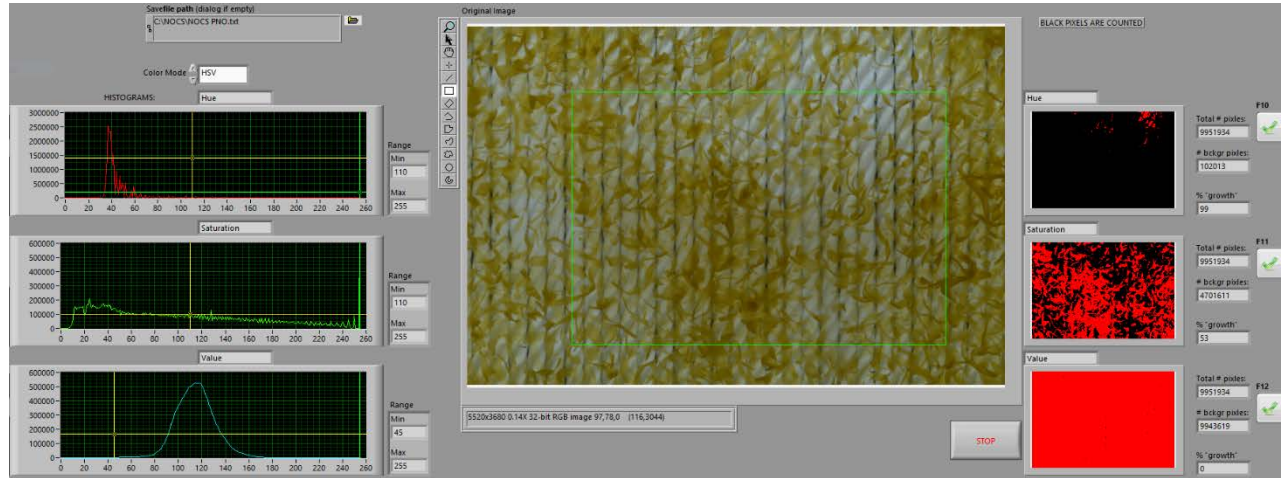
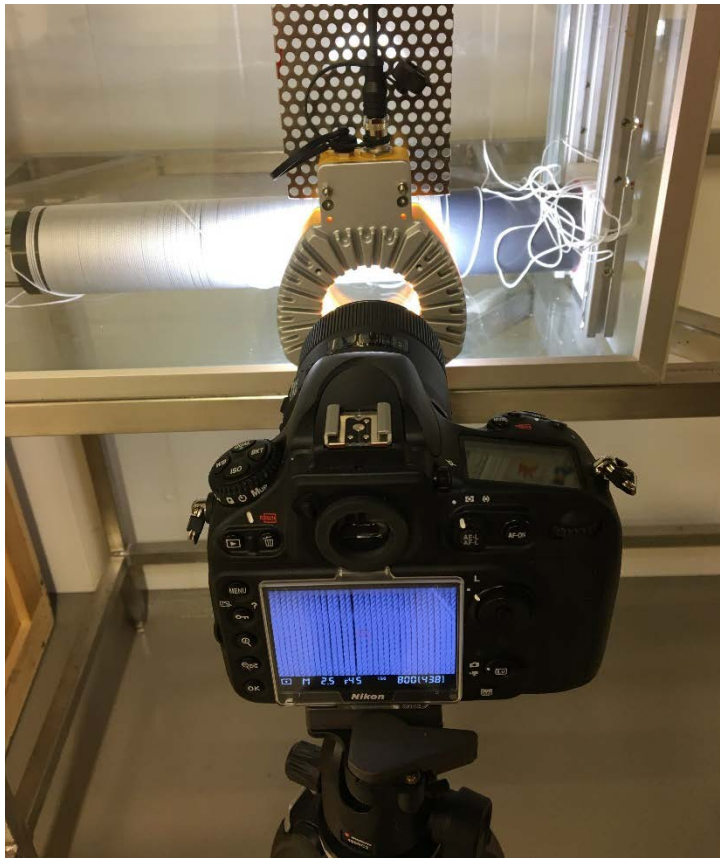
- Based on traditional chinese farm designs
- Replaces a boat with two operators
- Halves time spent harvesting
- Not automatic



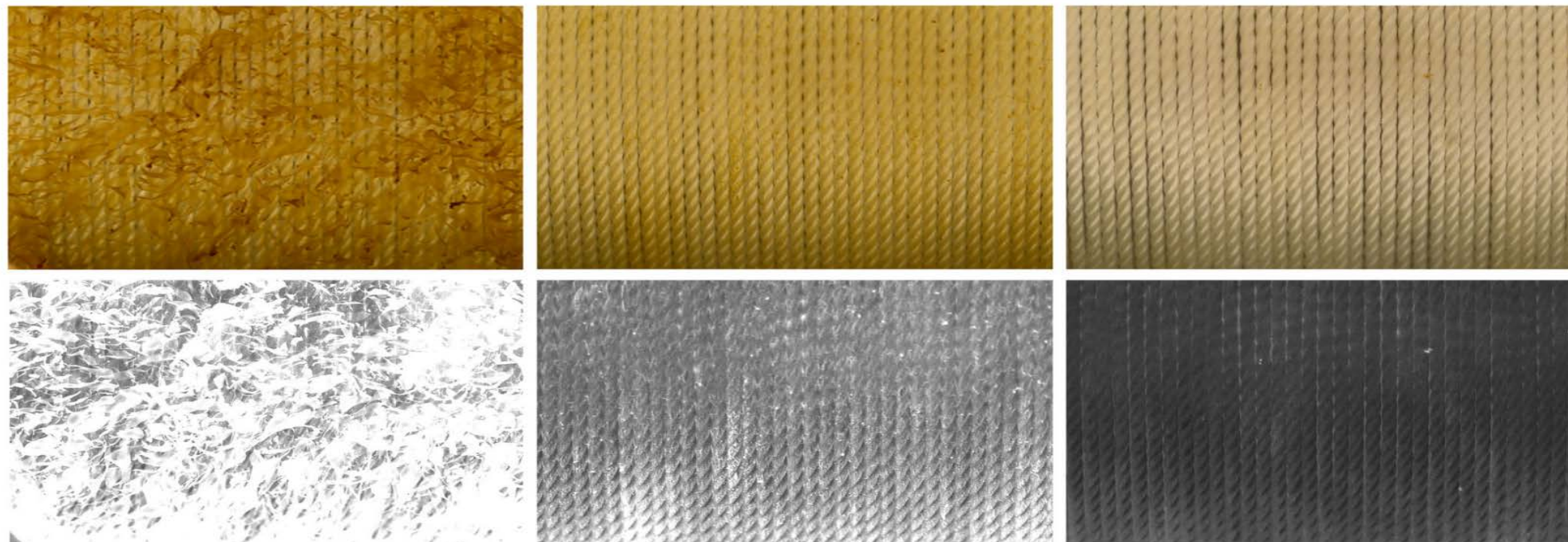
Industrial seedling production line



Quantification of spore density and gametophyte biomass



Instrumentation for quantification of spore density and gametophyte biomass



S42
Coverage: 84%

S28
Coverage: 58%

S21
Coverage: 25%

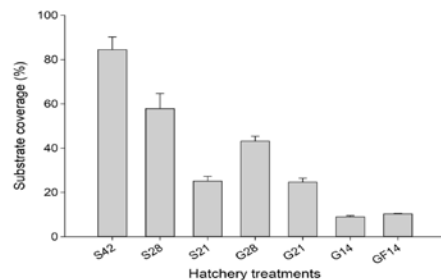


Fig. 2 Substrate coverage (%) before deployment of spore and gametophyte treatments on twine (see Table 1) incubated in the hatchery for 14–42 days. Mean \pm SD, $n=3$

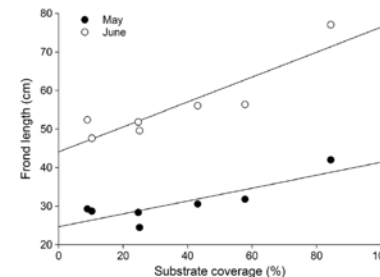


Fig. 6 The mean frond length (cm) for May and June as a function of the substrate coverage (%) at deployment in sea in February, with regression lines showing the linear trends

Automatic seeding

Preparation of spools with twine:

- The twine is initially fastened at the bottom end of the empty spools
- The machine will automatically spin the twine tightly around the spools, to the top, and stop when finished
- The spinning process takes approximately 90 seconds
- 150m twine capacity per cylinder



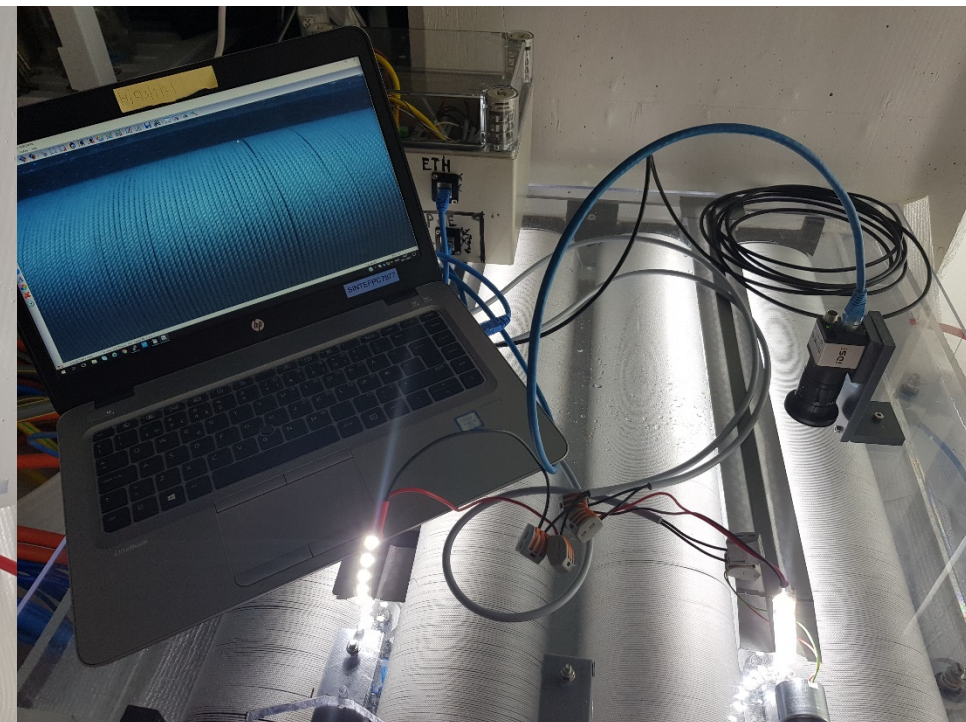
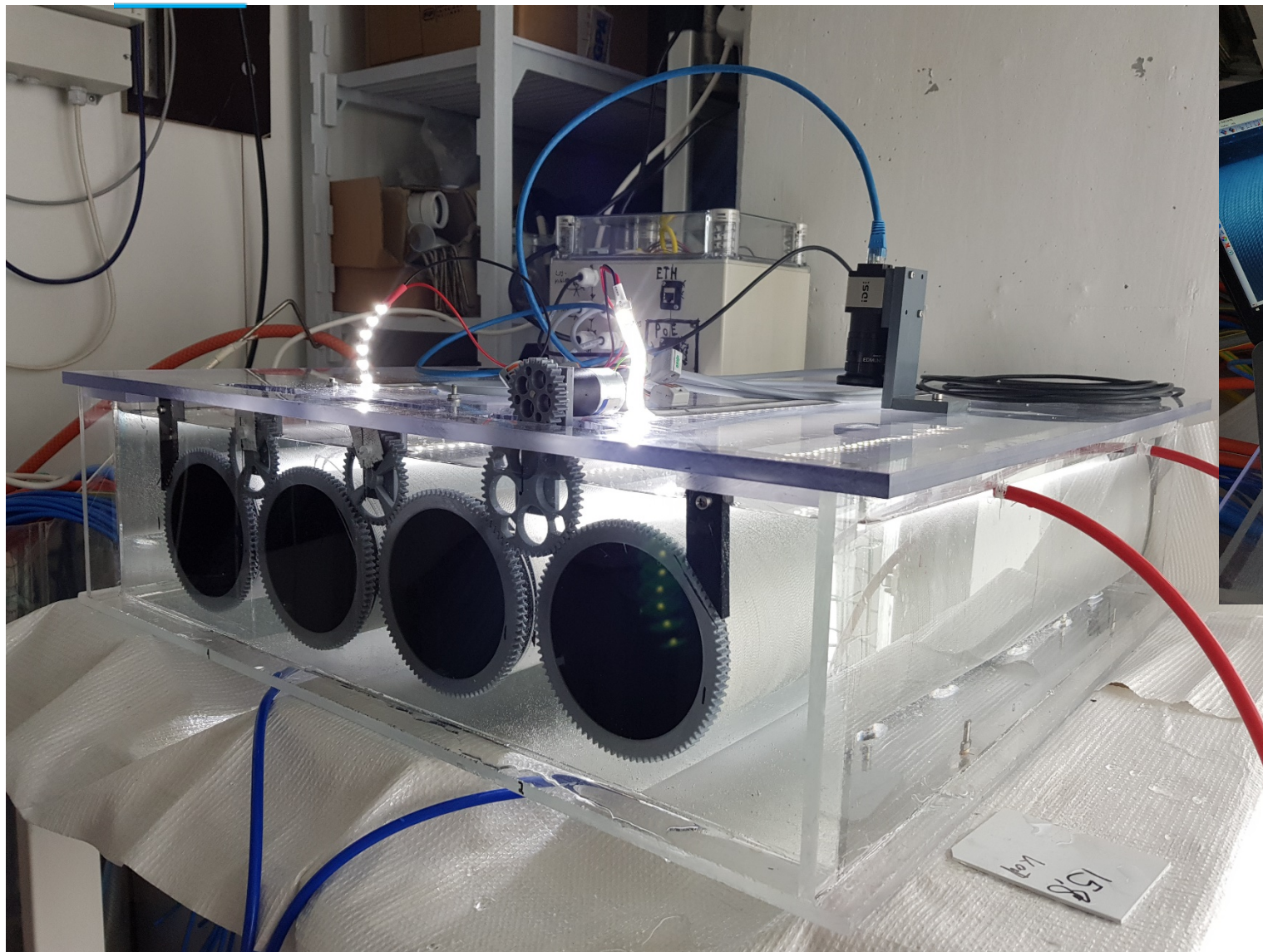
Automatic seeding

The image displays a control interface for an automatic seeding system. On the left, a schematic diagram shows a reactor system with 15 units. Each unit contains a growth light and seedling spools. The system is connected to an air supply and water supply. Key components include an air filter, air flow controller, valve, flow sensor, and temperature sensor, all connected to a control cabinet with a user interface.

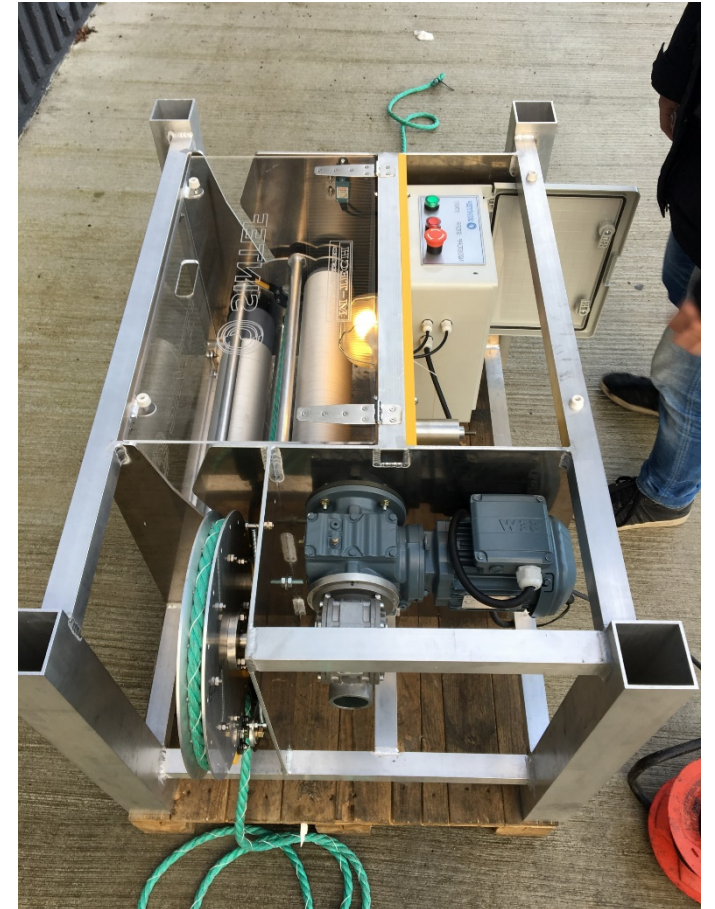
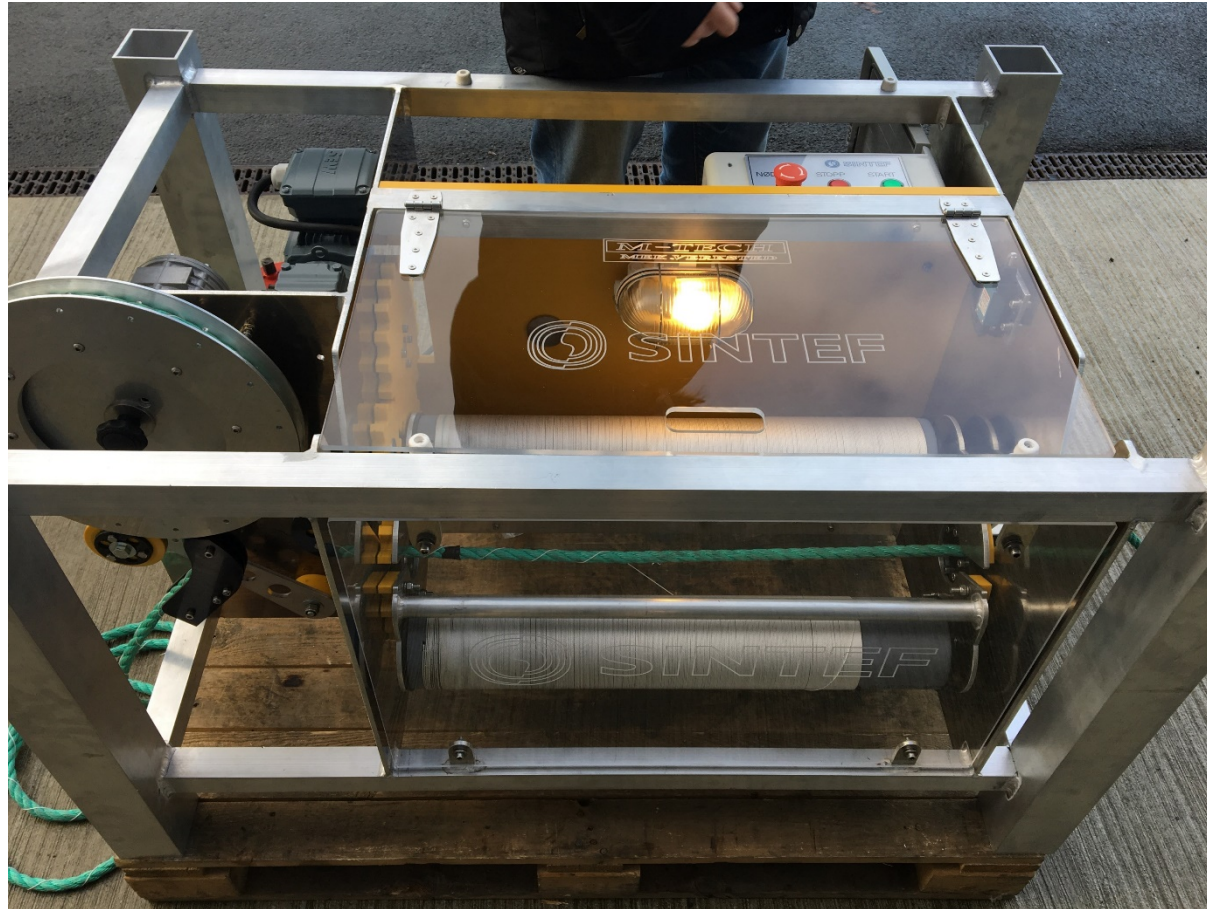
On the right, a 'Summary' window is overlaid, showing a 'New Session' configuration. The session name is 'Andreas H' and the duration is 70 days. The interface allows selecting reactors (7-15) and setting 'ON' and 'OFF' times. A table below the configuration shows the status of various reactors.

Reactor #	Temperature [°C]	Water Flow [L/min]	Owner	Time left
7	10.0	0.0	Aleksander H	59 Day(s), 24 Hour(s)
8	10.0	0.0	Aleksander H	59 Day(s), 24 Hour(s)
9	20.0	0.0	Aleksander H	59 Day(s), 24 Hour(s)
10	40.0	0.0	Aleksander H	59 Day(s), 24 Hour(s)
11	50.0	0.0	None	n/a
12	70.0	0.0	None	n/a
13	0.0	0.0	None	n/a
14	0.0	0.0	None	n/a
15	0.0	0.0	None	n/a

Automatic seeding



Automatic seeding

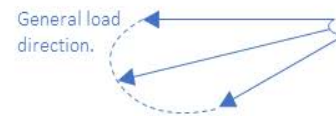
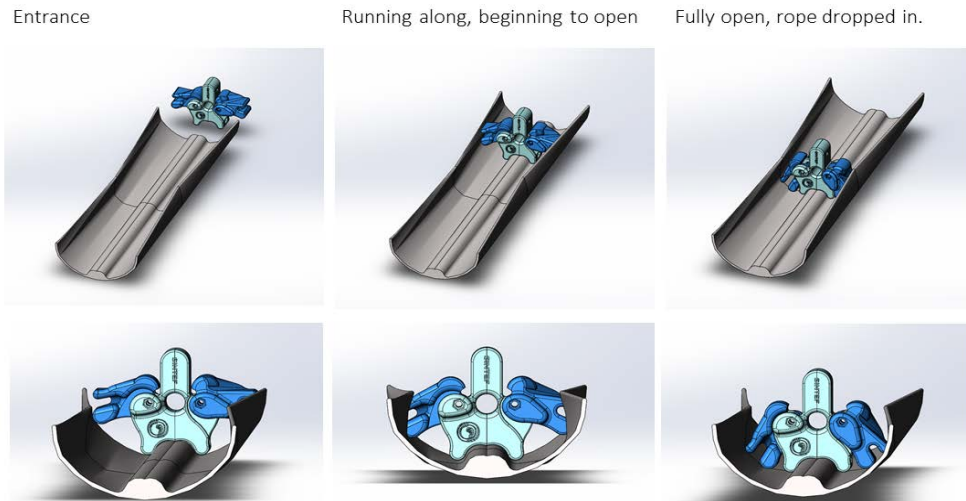


- Form factor: Fits on a Euro pallet
- Ships to field on a trailer or by boat

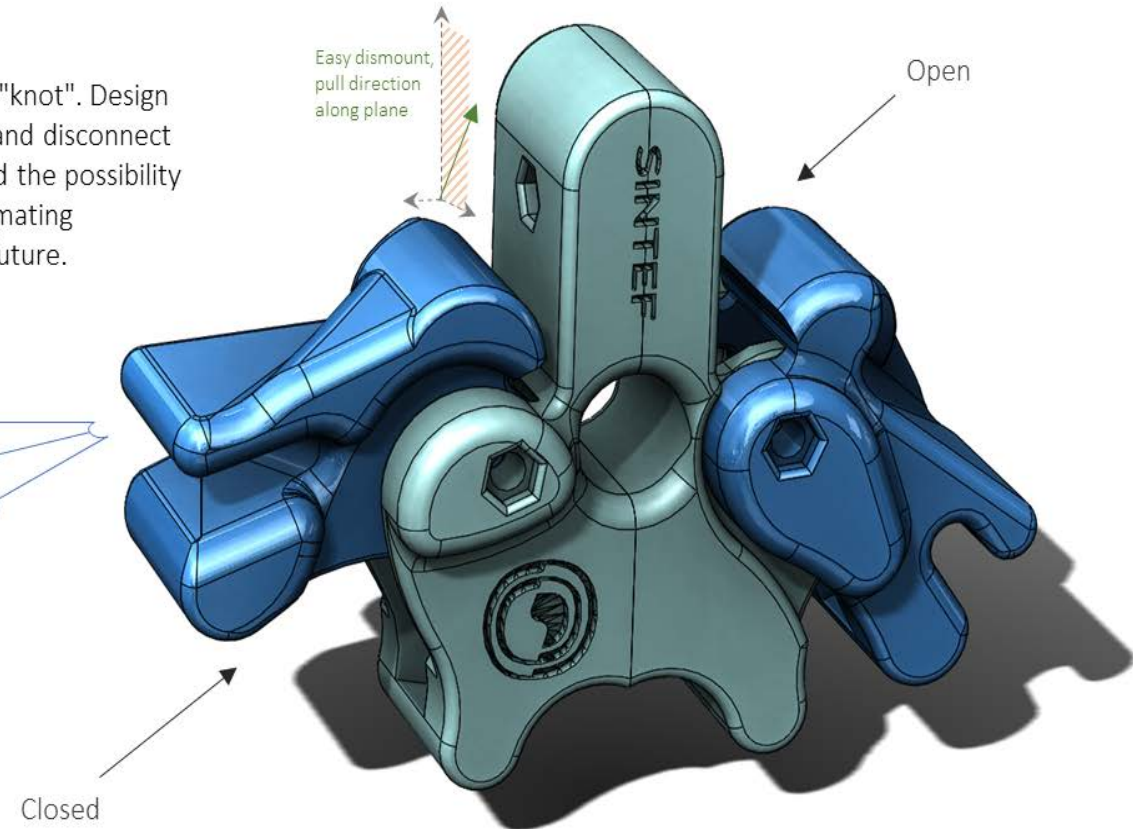
Mechanical knot

Substrate connector

A simple mechanical "knot". Design for easy attachment and disconnect of substrate rope, and the possibility of mechanizing/automating deployment in near future.



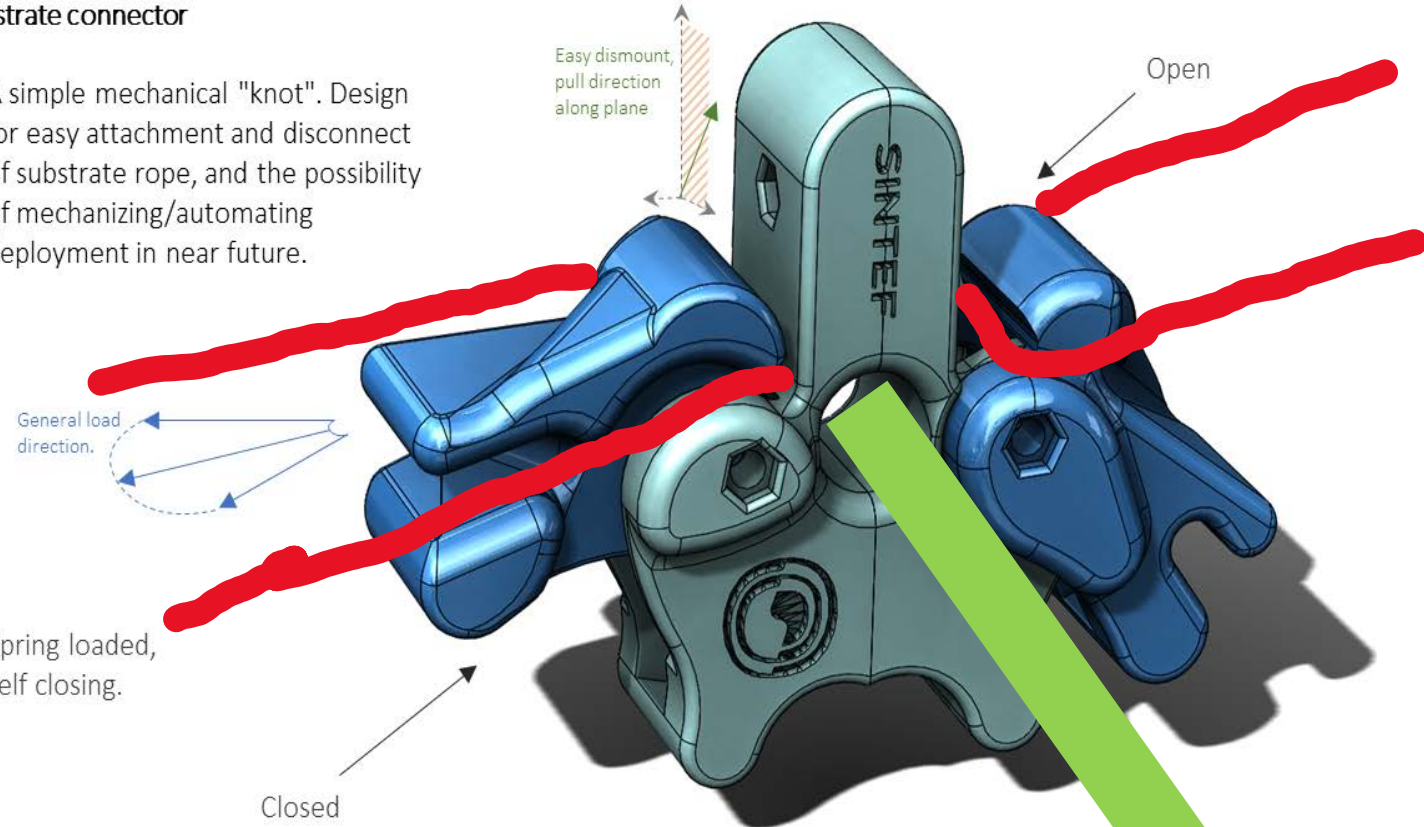
Spring loaded, self closing.



Mechanical knot

Substrate connector

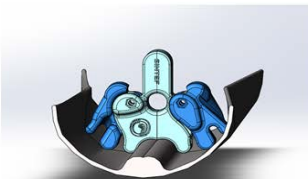
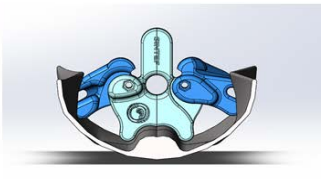
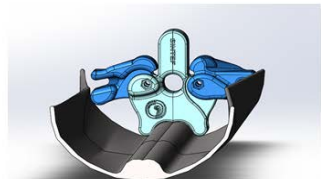
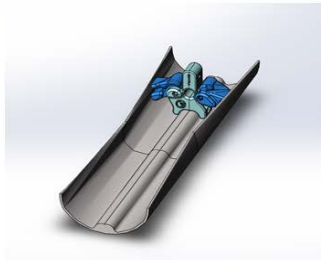
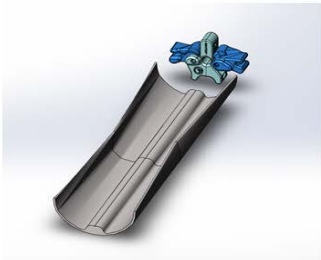
A simple mechanical "knot". Design for easy attachment and disconnect of substrate rope, and the possibility of mechanizing/automating deployment in near future.



Entrance

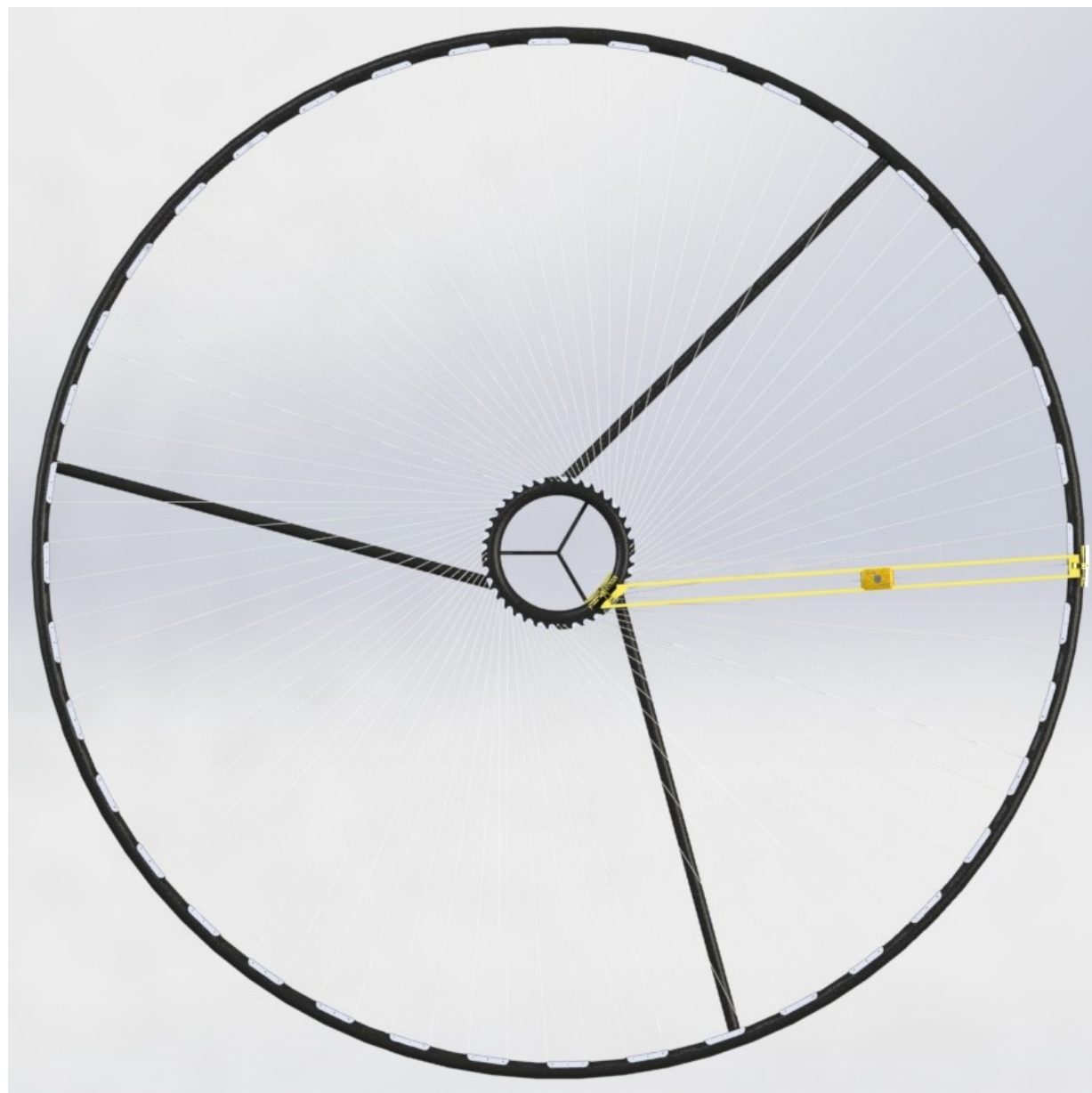
Running along, beginning to open

Fully open, rope dropped in.

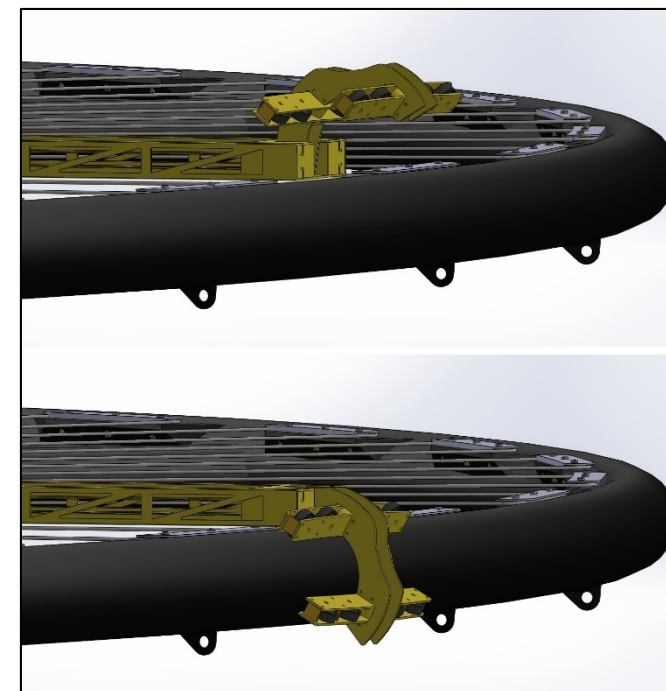
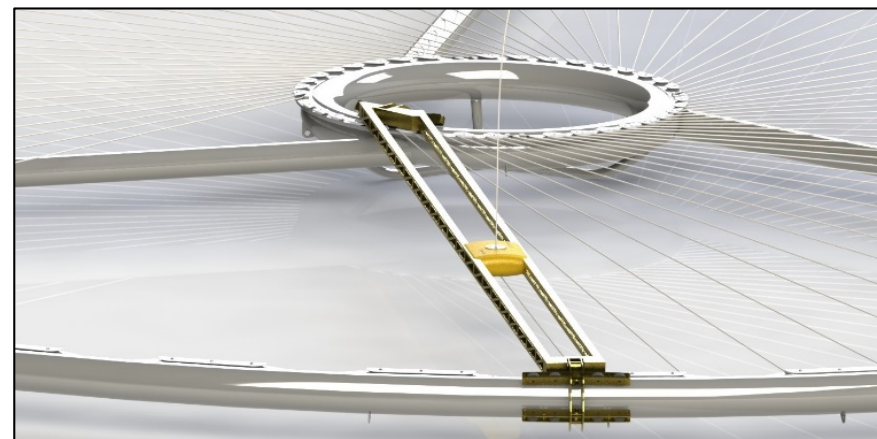
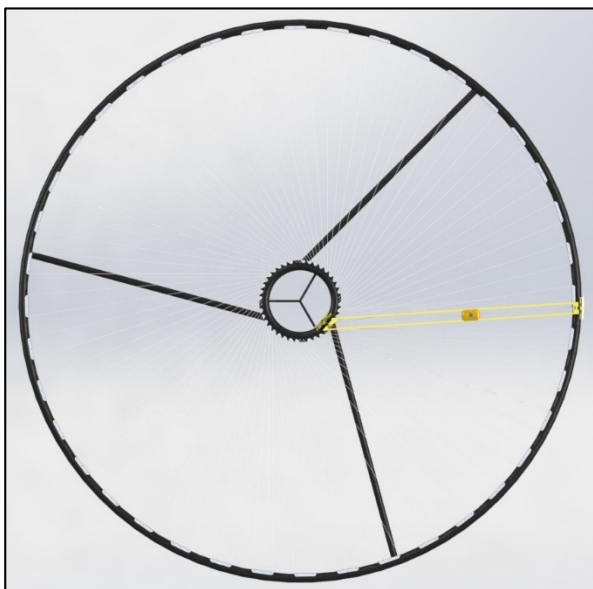


The SPOKe concept

- \varnothing 25 meter
- 400 mm HDPE tubes
- 896m of substrate
- Footprint: 491m²

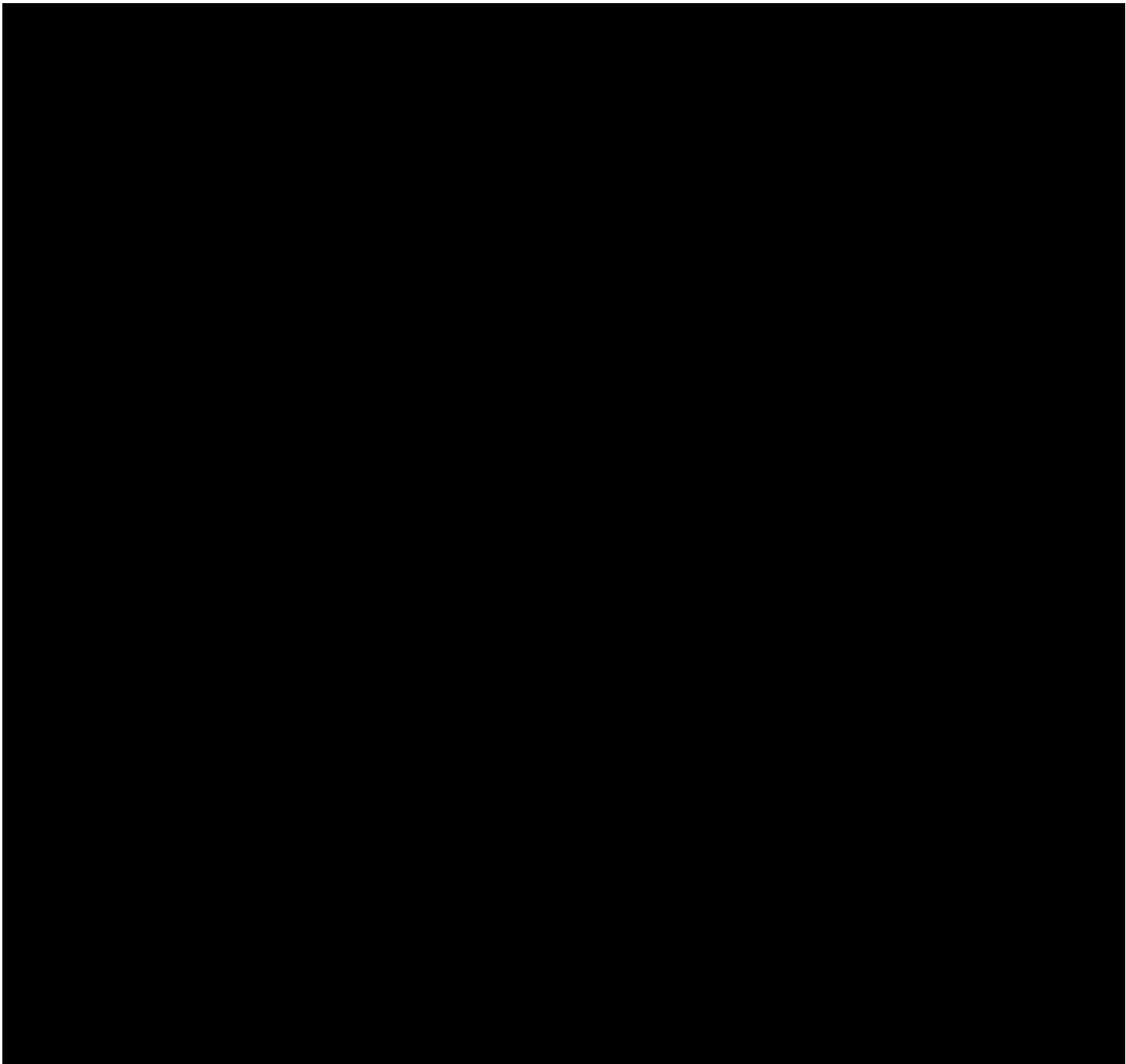


Gantry robot on rails



SPOKe prototype







Technology for a better society