Automation: way out for labour shortage

The first industrial robot was a welder robot invented in 1950. Over half a century later, although automation has been widely adopted in a broad range of industries, the construction industry still lags the industry average in implementing automation. While the construction industry has not been supported by any maturely developed robot and has remained manual labour dominant and intensive, age of the construction workforce starts eroding the long term viability of the industry, and construction welder is hit particularly hard.

A typical construction site in Hong Kong prepares 5,000 to 6,000 pieces of H-pile for piling, while each H-pile has five (5) to six (6) joints to be welded. This amounts to hundreds of construction welders are required for each construction site. However, the supply of construction welders is less likely to meet the demand in the long term.

Among the registered construction welders in Hong Kong, 63 % of them are over 50 years of age and only 5 % of them are 29 years old or below. Besides, it is forecasted that by 2022, the construction industry will short 1,500 construction welders. On the other hand, provided that the construction welders have to bear the harsh working environment, as they need to wear the heavy and thick protective clothing to protect themselves from the welding temperature can be as high as 2,000 C when the ambient temperature and relative humidity are both high, the construction industry is not surprising
to find itself hard to attract young people to join it and become construction welder. In fact, not only is it the phenomenon in Hong Kong, the trend of lacking construction welders is global.

To match the future demand of construction welder, and bringing a green youngster to become a welding master takes long time, automation of construction welding is a way forward.

**Automation: Agile deployment for construction sites**

The long well understood suitable closed and controlled environment for automation and implementing robotic operations is indoor, repetitive, pre-programmed, precise and work on standardised workpieces. Nevertheless, a typical construction site is outdoor and the workpiece geometries are highly diverse. In conjunction with the workpieces are normally prepared at site and do not enjoy high precision, the construction site environment is not suitable for implementing automation in the ordinary manner.

Ordinary industrial welding robots require the input of the three-dimensional (3-D) profile of the workpiece in order to programme the work sequence, while tooling and commissioning demand minimum one (1) week to proceed with mass production. In a construction site, the weld surfaces are often prepared *in-situ* and no prior information about the workpiece profile is available at all, whereas the fast pace nature of the construction industry can only tolerate a weld joint to be welded within hours. Moreover, very often the workpieces to be welded at the construction sites are prepared by flame cutting, resulting in the weld gaps are non-uniform and in poor profile.

A solution for robotic welder possible is using adaptive robotic control (ARC). Instead of inputting the weld joint full 3-D profile in advance, ARC only needs two (2) points of start and finish to define the weld joint, and the weld joint geometry is non-contact 3-D scanned by laser sensing. The scanned data is processed by numerical algorithms to derive the weld path, including compensation weaves in zig-zag, triangular or spring form, which are the outcomes of capturing the know-how of the experienced construction welders, and transforming their techniques and craftsmanship into the algorithm and operation commands. Whenever multi-layer welding requires, ARC, supplements by artificial intelligence, derives the number of pass needed and programmes the beads layout. After the weld gap is well filled with beads, the weld joint is laser scanned once again to determine the top layer profile, and the top layer is welded accordingly. Not only can the adaptive robotic welder weld straight lines, it can also weld non-straight lines and curvature surfaces.

**Automation: Safety for construction sites**

To be agile in deploying in construction sites, safety is of priority concern for the adaptive welding robot. The ordinary industrial robotic welders have no mechanism to halt their motion in case of hit; thus their operating area has to be shielded for the safety of the human workers. Conversely, fencing is not possible for the robotic welders working in construction sites due to the site constraints and the requirement of agile deployment. They need to sense impacts and proactively stop their motion in protection of the workers on impact and in vicinity.

Robotic Devices – collaborative robots”. Collaborative robots are available in a range of weight and working radius capacities, from 3 kg at 500 mm to 10 kg at 1,300 mm.

The integration of ARC and weld gun into a collaborative robot forms the highly autonomous, flexible and durable to deploy and operate adaptive robotic welder. Only few workers locate the adaptive robotic welder about one (1) feet from the weld joint using just tape measure and visual level check, and laser scanning and weld path programming take place autonomously. Once installed, which takes about 15 minutes, the adaptive robotic welder then executes the welding programme in six (6) axises and a weld joint is done. Working on the next weld joint, even though the profile is vastly different to the previous one, the adaptive robotic welder tailor-makes the welding regime for it without any need of re-tooling itself.

Should the workpiece be a H-pile, the adaptive robotic welder can be clamped on the H-pile and the robotic arm can travel in one (1) goal to complete welding of all six (6) sides. Apart from tungsten inert gas welding which first pass needs to be done manually, the adaptive robotic welder can perform metal inert gas, metal active gas and flux-cored welding fully autonomously following the existing Welding Procedure Specifications (WPS) developed by manual welding. The development of WPS for adaptive robotic welder are in progress.

**Remarks**

Adaptive robotic welder is a solution to the shortage of construction welders. Adaptive robotic welder must be simple and easy to deploy, fully autonomous, highly tolerant to precision and able to stop motion upon impact in order to perform in the demanding environment of construction sites safely. Welbot Technology Limited (Welbot) offers the construction industry adaptive robotic welders, which procurement for use will enjoy 70% price subsidy from Construction Innovation and Technology Fund under Construction Industry Council. The solution for construction welding is there.

Institution of Mechanical Engineers Hong Kong Branch (IMechE-HKB) thanks Mr. Stanley Ho, the Welbot Co-founder, for sharing the technologies of adaptive robotic welder in the IMechE-HKB evening lecture on 23/10/2019.

*** END ***

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Encl.
WHT
VISION

AS A PIONEER TO IMPLEMENT CONSTRUCTION SITES WITH INTELLIGENCE, HARMLESS, EFFICIENCY AND COST EFFECTIVE CONSTRUCTION ROBOTIC SYSTEM
WELBOT COMPANY STRUCTURE

Welbot Technology Limited (HK)
- Welbot Head Office
- HKSTP Incu-Tech

Welbot Technology (Shenzhen) Limited
- Welbot SZ Branch Office
- Hold the Patent
  - (Application Code: 201710943375.5)
  - (Application Code: 201910780609.8)

11 Number of R&D staff of robotic welding
2 Number of PhD
3 Number of Master
WELBOT BUSINESS

- A group of Experienced Engineers and Professionals in Mechanical, Programming and Robotics Field

2015
- Severe Labor Shortage in Construction Industry
- Pilot Study in implementation of Robotic System in Construction Field
- Invented Adaptive Robotic Welder and Cable Robotic Cleaner and applying the relevant IPs

2018
- Test Run of Robots in construction site with Vibro, Chun Wo

2019
- First Launch of Adaptive Robotic Welder and Cable Robotic Cleaner
ADAPTIVE
ROBOTIC WELDER
ON SITE WELDING CHALLENGES

1. SHORTAGE OF SKILLED WELDERS

Demographic of Registered Welders

- Below 29: 5%
- 30-49: 32%
- 50 or above: 63%

From Construction Industry Council-Welding Workers Registration Data Analysis Report (2017-18)
ON SITE WELDING CHALLENGES

1. SHORTAGE OF SKILLED WELDERS

From Construction Industrial Council Report of CIC Manpower Forecasting Model 2018 (Skilled Construction Workers) (May 2019)
ON SITE WELDING CHALLENGES

2. LIMITATION IN APPLYING INDUSTRIAL WELDING ROBOTS

- Experienced Robotic Engineers required
  - Long Set up time consumed

- At least 6-8 hours for programming industrial welding robots on site due to
  - Harsh Construction Site Environment
  - Precise Alignment required
KEY FACTOR OF CONSTRUCTION AUTOMATION

- Traditional Manufacturing Automation: it spend 1 week to prepare the Mass Production

- But it do not accept by Construction industry to spend the same time to complete ONE JOB

- Successful Construction Automation solution Should be minimum the Time of pre-programing, and fulfil the task Flexibility
OUR SOLUTION

ADAPTIVE ROBOTIC WELDER

Leading Core Technology
Adaptive Robotic Control (ARC)

Construction Site Ready
High Efficiency, Less Wastage
User Friendly Operation
More Safety, Less Casualty
The FIRST and ONLY robot technology
Prefect Welding, Consistent Quality

Prefect Welding, Consistent Quality

More Safety, Less Casualty

User Friendly Operation

High Efficiency, Less Wastage

Construction Site Ready

Prefect Welding, Consistent Quality

The FIRST and ONLY robot technology

Leading Core Technology
Adaptive Robotic Control (ARC)
H-PILE WELDING IN FOUNDATION
ELS WELDING IN FOUNDATION
STRUCTURE WELDING

- Large-scale Construction projects continuous implement globally
ROBOT WELDER TARGET SECTOR

- Construction Site Welding (H-beam, Bore Pile...etc)
- Outdoor Oil Pipe connection Welding
- One-Off Structure Pre-workpiece Welding
- On-site Maintenance Welding
- Ship building
ADAPTIVE ROBOTIC CONTROL
OUR SOLUTION

ADAPTIVE ROBOTIC CONTROL - COMPRESS ROBOTIC PROGRAMMING

Data Collected by Laser Sensor

• Contactless collection
• Precise measurement
• Instant modelling

Numerical Algorithm

• Normal fitting
• Curve fitting
• AI noise filtering
**FUNDAMENTAL TECHNOLOGY**

**ADAPTIVE ROBOTIC CONTROL**

Traditional method:
Need 3D CAD Model and Robot Simulator

Robotic Adaptive Control:
Only 2 points are needed for

Robot Path Task for normal to surface

Robotic path required to drive the tool
FUNDAMENTAL TECHNOLOGY
ADAPTIVE ROBOTIC CONTROL

Robotic path Auto Generation by ARC
ADAPTIVE ROBOTIC CONTROL

- Compress robotic programming task
- Use laser sensor and numeric method to extract data
- Non-contact Scanning
  - 3D Point
  - Work normal by numerical method
  - Line by numerical method
  - Free form workpiece
• Welding
• Polishing
• Wall finishing
• Drilling
• Inspection
• Painting
OUR SOLUTION

ADAPTIVE ROBOTIC WELDER ON SITE WELDING

１ Worker install on approximately position and start scan
OUR SOLUTION

ADAPTIVE ROBOTIC WELDER ON SITE WELDING

② Scan Workpieces
OUR SOLUTION

ADAPTIVE ROBOTIC WELDER ON SITE WELDING

③ Auto Weld Path
OUR SOLUTION

ADAPTIVE ROBOTIC WELDER ON SITE WELDING

④ Worker confirm and start
OUR SOLUTION

ADAPTIVE ROBOTIC WELDER ON SITE WELDING

Live data to preform accurate welding
OUR SOLUTION

ADAPTIVE ROBOTIC WELDER ON SITE WELDING

Auto – Al Multilayer
Feature

- Intuitive User interface
- Auto-WeldPath Generation
- 3D Welding Weave
- Complex Welding Path
  - Non-Straight Welding
  - Curvature surface welding
- Gap compensation
- Multi-Layer Auto Weld
SMARTWELD FEATURE
AUTO-WELDPATH GENERATION

- Welding Target
- Approximate point out the welding location (by Worker)
- SMARTScan the welding Profit
- Auto-Weld path generated
SMARTWELD FEATURE
3D WELDING SWING WEAVE

To Fulfil Complex requirement

- Zigzags Welding Weave
- 3D Welding Weave
  - Spring
  - Triangle
SMARTWELD FEATURE
COMPLEX WELDING PATH

- Non-Straight Welding
- Curvature surface welding

(Advance Option)
FEATURE
GAP COMPENSATION

Intelligent Gen-Welding Path

un-uniform gap

Intelligent Gen-Welding Weave

Real parts issue in construction

Intelligent compensation Weave
(Advance Option)
SMARTWELD FEATURE
MULTI-LAYER AUTO WELD

Re-Scanning after last layer welded
And Generate the next layer’s Welding path

(Advance Option)
SMARTWELD FEATURE
MULTI-LAYER AUTO WELD
SMARTWELD FEATURE
MULTI-LAYER AUTO WELD
SMARTWELD FEATURE
MULTI-LAYER AUTO WELD
SMARTWELD FEATURE
MULTI-LAYER AUTO WELD
SMARTWELD FEATURE
MULTI-LAYER AUTO WELD
SMARTWELD FEATURE
MULTI-LAYER AUTO WELD
SMARTWELD FEATURE
MULTI-LAYER AUTO WELD
CASE REFERENCE- OUTDOOR WELDING
CASE REFERENCE - OUTDOOR WELDING
## COMPETITIVE ANALYSIS

### ADAPTIVE ROBOTIC WELDER VS MARKET WELDERS

<table>
<thead>
<tr>
<th>Feature</th>
<th>Adaptive Robotic Welder</th>
<th>Industrial Robotic Welder</th>
<th>Auto Guided Machine</th>
</tr>
</thead>
<tbody>
<tr>
<td>Construction Site</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>Machine</td>
<td>6 axis Robot Arm (Cobot)</td>
<td>6 axis Robot Arm</td>
<td>Guided rail</td>
</tr>
<tr>
<td>Weight of System</td>
<td>30Kg</td>
<td>200Kg+</td>
<td>30Kg</td>
</tr>
<tr>
<td>Allowed Workpieces Tolerance</td>
<td>High</td>
<td>Low</td>
<td>Low</td>
</tr>
<tr>
<td>Installation</td>
<td>15 mins</td>
<td>1 day+</td>
<td>2 Hour +</td>
</tr>
<tr>
<td>Programable welding Path</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Programming Time</td>
<td>2-5 mins</td>
<td>2hour +</td>
<td>Nil</td>
</tr>
<tr>
<td>Multi-Pass welding</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
</tr>
</tbody>
</table>
SAFETY
COLLABORATIVE AND SAFE

• The safety system is approved and certified by TÜV (The German Technical Inspection Association)

• Achieved ISO/TS 15066 standard for collaborative robot

• Replace human operators in dirty, dangerous and dull jobs to reduce repetitive strain and accidental injuries
UR ROBOTS MEET THE BELOW INTERNATIONAL STANDARDS:

- German Technical Inspection Association Certificate

ISO 10218-1,2
ISO 12100
ISO 13849
ISO TS 15066
Collaborative Robot Features

NO SAFETY FENCE
# ROBOT SERIES

**PICK THE RIGHT COBOT FOR YOUR AUTOMATION**

<table>
<thead>
<tr>
<th>Robot</th>
<th>Automate tasks up to</th>
<th>Working radius</th>
</tr>
</thead>
<tbody>
<tr>
<td>UR3</td>
<td>3Kg</td>
<td>500mm (Best deployed in tight spaces or on table tops)</td>
</tr>
<tr>
<td>UR5</td>
<td>5Kg</td>
<td>850mm</td>
</tr>
<tr>
<td>UR10</td>
<td>10Kg</td>
<td>1300mm (For tasks across large areas)</td>
</tr>
</tbody>
</table>
WELBOT
BACKGROUND
WELBOTS COMPANY STRUCTURE

- Welbot Technology Limited (HK)
  - Welbot Head Office
  - HKSTP Incu-Tech

- Welbot Technology (Shenzhen) Limited
  - Welbot SZ Branch Office
  - Hold the Patent
    - (Application Code: 201710943375.5)
    - (Application Code: 201910780609.8)

11 Number of R&D staff of robotic welding
2 Number of PhD
3 Number of Master
### INDUSTRY RECOGNITION

#### Project Reference

<table>
<thead>
<tr>
<th>EMSD</th>
<th>Adaptive Polishing Robot</th>
<th>Robot Soft Drink Automation line</th>
</tr>
</thead>
<tbody>
<tr>
<td>CLP</td>
<td>Robotic Bar Tender</td>
<td>Inspection Production-line</td>
</tr>
<tr>
<td>HKSTP</td>
<td>Collaborative Robot</td>
<td>Robot Motor Assemble line</td>
</tr>
<tr>
<td></td>
<td>Milk Tea Robot</td>
<td>Welding Robot</td>
</tr>
</tbody>
</table>

The welding robotic control software could automatically generate the weld path, perform 3D welding weave, complex, non-straight welding paths. It can set up the robot task within 2 minutes. The robot can provide standard welding quality to improve productivity by replacing experienced welders on site.

The weight of six-axis robot arm is light (11-28kg) with (0.5-1.3m) reach radius provide flexible mobility requirement for construction industry.

This automatic welding robot can complete various types of welding processes in 3D. The robot arm can be used in construction and manufacturing. The robot arm is ideal for high precision welding tasks in various industries.

The collaborative robot is designed for flexible manufacturing operations. It can work closely with human operators in a shared workspace, enhancing productivity and safety.

The adaptive polishing robot is designed to improve production efficiency and ensure safety on the production line.
THANKS
We believe in the nearly future, robot operating should be extremely easy and could be done by anyone, whatever the age, education or else. Our team focused on making it becomes a reality in construction automation using our core patent pending technology “Adaptive Robotic Control” (ARC). ANYONE can easily and intuitively set up the industrial Robot task within 2 MINS. It is a breakthrough in construction automation area and revolutionary in Automated Welding Solution.
Welbot Robot Welder (Listed in CITF Pre-approved List item: PA19-001)

Welbot devoted to bringing safe, flexible, and easy-to-use collaborative robots for Construction Welding Automation. World Supreme light weight (18-28kg) of Six-axis Robot arm with (0.85-1.3m) reach radius provide a flexible mobility requirement for construction industry. With this approach, we help construction company assign their operators to more enjoyable Intuitively functions – thereby helping provide them with new challenges and add value to the company.

Adaptive Robotic Control (ARC)
Use precision laser sensor tracking welding path form large variation (Position/Tol.) workpieces on Construction-site. Intuitive UI allow anyone setup in 2 MINS

Support manual weld gun
Welbot Welder design under construction environment, common manual weld gun and laser sensor can be mounted on fixture. (Support Robot Weld gun)

FEATURE

- Intuitive User interface
- Gesture Control
- Auto-WeldPath Generation
- Complex Welding Path
  - Non-Straight Welding
  - Curvature surface welding
- 3D Welding Weave
- Gap compensation (Advance)
- Multi-Layer Auto Weld (Advance)
- Zero Program Intelligent Welding (H-Pile, Standard Structure)

Wide range welding machine
Welbot Welder support GAS protection ARC welding and Flux cored ARC welding, which is common used in construction industry. (Support MIG MAG)

Moving platform
Welbot Welder can be installed on remote control tracked vehicle, its advantage allow Robot move on harsh environment such as construction site.

Specific task platform
Welbot Welder can be installed on specific fixture and operate with ARC dedicate module (Zero Program Intelligent Welding such as H-Pile welding.
Welbot Technology is well-versed in Robotic Integration Solutions. Our team include professional development programmer, Mechanical Engineer and Electrical Engineer. We have an assembly workshop located in Hong Kong and Shenzhen to support our clients covered in Asia.

Benefit of Welbot
Welbot has timely and complete after-sales service
Strong ability of independent development.
Fully Customization by customer requirements.

Vertical Robotic Solution
KUKA offers a wide range of various payload capacities and reaches. Collaborative robots (Cobot) are Cost-effective, flexible, safe, and easy-to-use. Welbot Technology provides a full range robot product for professional automation solution to our clients, such as Industrial Robot, Collaborative Robot (Cobot), Robot Accessories, and Robotic Simulator.

Collaborative Robot

KUKA offers a wide range of various payload capacities and reaches.

Industrial Robot

Stäubli Robotics recognized for their efficiency and reliability.

Robot Accessories

One stop for END-OF-ARM Tooling.

AI 3D Vision

Machine Learning AI 3D Vision.

Robotic Simulator

Program any Industrial Robot with One Simulation Environment.

### Welbot Robot Welder Spec

<table>
<thead>
<tr>
<th>Software</th>
<th>Universal Welder</th>
<th>Zero Program Welder</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intuitive User interface</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Gesture Control (Option)</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Complex Welding Path (Curve)</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>3D Welding Weave</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Gap compensation</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>Multi-Layer</td>
<td>Manual define start point</td>
<td>Auto-Scan</td>
</tr>
<tr>
<td>Zero Program</td>
<td>No</td>
<td>Yes require Specific Mount</td>
</tr>
<tr>
<td>Laser Sensor</td>
<td>Precision Point Laser</td>
<td>Precision Line Laser</td>
</tr>
<tr>
<td>Laser Sensor Protector</td>
<td>Manual / Auto (Option)</td>
<td></td>
</tr>
<tr>
<td>Welding Machine</td>
<td>Robotic Weld Gun / Manual Weld Gun</td>
<td></td>
</tr>
<tr>
<td>Mounting Platform (Option)</td>
<td>Quick Mount / Specific Module Mount</td>
<td></td>
</tr>
<tr>
<td>Moving Platform (Option)</td>
<td>Remote Control Tracked Vehicle (Option)</td>
<td></td>
</tr>
</tbody>
</table>

### UNIVERSAL ROBOTS Spec

<table>
<thead>
<tr>
<th>UR3</th>
<th>UR5</th>
<th>UR10</th>
</tr>
</thead>
<tbody>
<tr>
<td>Repeatability</td>
<td>0.1 mm</td>
<td>0.1 mm</td>
</tr>
<tr>
<td>Ambient temperature range</td>
<td>0-50° C</td>
<td>0-50° C</td>
</tr>
<tr>
<td>Power consumption</td>
<td>Typical 125W</td>
<td>Typical 150W</td>
</tr>
<tr>
<td>Safety Collaboration</td>
<td></td>
<td>TüV NORD Approved Safety Function</td>
</tr>
<tr>
<td>Payload</td>
<td>3 kg</td>
<td>5 kg</td>
</tr>
<tr>
<td>Reach</td>
<td>500mm</td>
<td>850 mm</td>
</tr>
<tr>
<td>Degrees of freedom</td>
<td>6 rotating joints</td>
<td>6 rotating joints</td>
</tr>
<tr>
<td>Working range - All Joint</td>
<td>± 360°</td>
<td>± 360°</td>
</tr>
<tr>
<td>Working range - End of Tooling</td>
<td>Infinite</td>
<td>± 360°</td>
</tr>
<tr>
<td>Maximum speed</td>
<td>1 m/Sec.</td>
<td>1 m/Sec.</td>
</tr>
<tr>
<td>IP classification</td>
<td>IP64</td>
<td>IP54</td>
</tr>
<tr>
<td>ISO Class Cleanroom</td>
<td>5</td>
<td>6</td>
</tr>
<tr>
<td>End Tool I/O port / Power</td>
<td>DI 2 / DO 2 / AI 2 / 12V/24V 600mA</td>
<td></td>
</tr>
<tr>
<td>Control Box I/O port / Power</td>
<td>DI 16 / DO 16 / AI 2 / AO 2 / 24V 2A</td>
<td></td>
</tr>
<tr>
<td>Communication</td>
<td>TCP/IP 100Mbit, Modbus TCP, Profinet, EthernetIP</td>
<td></td>
</tr>
<tr>
<td>Power</td>
<td>100-240 VAC, 50-60 Hz</td>
<td></td>
</tr>
<tr>
<td>Weight</td>
<td>11 kg</td>
<td>18.4 kg</td>
</tr>
</tbody>
</table>

### Additional Spec for e-Series

<table>
<thead>
<tr>
<th>UR3e</th>
<th>UR5e</th>
<th>UR10e</th>
</tr>
</thead>
<tbody>
<tr>
<td>Repeatability</td>
<td>0.03 mm</td>
<td>0.03 mm</td>
</tr>
<tr>
<td>F/T Sensor - Force/ Torque, x-y-z Range</td>
<td>30N / 10Nm</td>
<td>50N / 10Nm</td>
</tr>
<tr>
<td>Resolution</td>
<td>1.0N / 0.02Nm</td>
<td>2.5N / 0.04Nm</td>
</tr>
<tr>
<td>Accuracy</td>
<td>3.5N / 0.10Nm</td>
<td>4.0N / 0.30Nm</td>
</tr>
<tr>
<td>IP classification</td>
<td>IP54</td>
<td>IP54</td>
</tr>
<tr>
<td>End Tool I/O port / Power</td>
<td>DI 2 / DO 2 / AI 2 / RS-485 / 12V/24V 600mA continuous, 2A peak</td>
<td></td>
</tr>
<tr>
<td>Control Box I/O speed</td>
<td>500 Hz control, 4 separated / high speed quadrature digital inputs</td>
<td></td>
</tr>
<tr>
<td>Weight</td>
<td>11.2 kg</td>
<td>20.6 kg</td>
</tr>
</tbody>
</table>