

Friction stir welding

For stronger welds and lighter assemblies



CRIQ
INNOVATION PARTNER

Benefits



A compact system offering extensive flexibility and unparalleled movements

CRIQ offers a robotic friction-stir welding solution that can be customized to your specific needs.

A robotic welding system brings major benefits compared to conventional static equipments, particularly regarding its much higher flexibility. This kind of robotic solution makes it possible to weld even the most complex assemblies and trajectories, it is also quick and relatively simple to program. A welding robot can also be used for friction stir spot welding (FSSW).

Moreover, a robot such as the one used in CRIQ's solution can be customized easily to different applications. Its input and outputs can be used to communicate with the environment, to quickly accessories and end-effectors, and perform highly diverse tasks. A robotic solution can also integrate different types of sensors to make it aware of its surroundings, and to perform specialized tasks and applications. It is much more compact than similar static (gantry) solutions and often a much smaller expense.



Description



Welding solution and simulation tools

CRIQ uses a *Fanuc M900/600iA* robot for its friction-stir welding solution. This robot boasts a payload of 700kg suitable for this type of application, making it ideal for welding plates measuring up to $\frac{1}{4}$ of an inch of 6061-T6 aluminium. It is equipped with a controller offering a myriad of possibilities. Among other things, it includes analog and digital outputs as well as USB and Ethernet connection ports. Its HMI consists of a teach pendant equipped with a touch screen. It can be used to access all parameter pages, including those used for configuration, programming and input-output. It can also be used to manually re-orient the robot in its workspace, either a cartesian system or articular coordinates. Each axis on the robot servo-motor equipped, thus, they can provide their Cartesian or articular position at all times.

Two programming languages

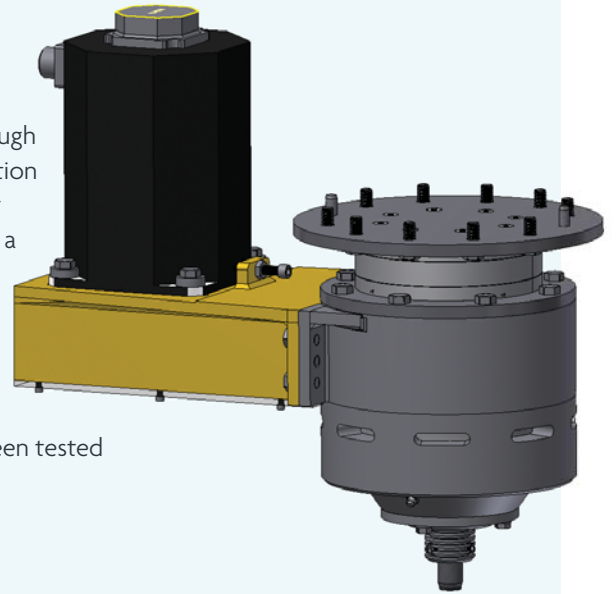
Fanuc robots can be programmed using two different languages. The first one is called *TP*. The user can program the robot using this language with the teach pendant (online programming). *TP* is a language that contains high-level instructions making it possible to easily execute movements, easily control inputs and outputs, launch sub-programs, read or write registers and perform other similar operations.

The second language is called *KAREL*. This language cannot be programmed directly on the teach pendant. It must be written directly in the robot simulator on a desktop computer. It is a much less intuitive language than *TP*, it is however more flexible, particularly when it comes to mathematical operations. Most programs written by CRIQ use this language. Programs written in *KAREL* must be compiled in order to be operational. The simulator is a software application called *Roboguide*. Ideally, it should be installed on a desktop computer located near the robot and connected to the latter using Ethernet. It is possible to entirely recreate the workcell in 3D and write *TP* or *KAREL* in simulation scripts. CRIQ's solution includes the development of this type of 3D virtual environment, of course depending on the application.



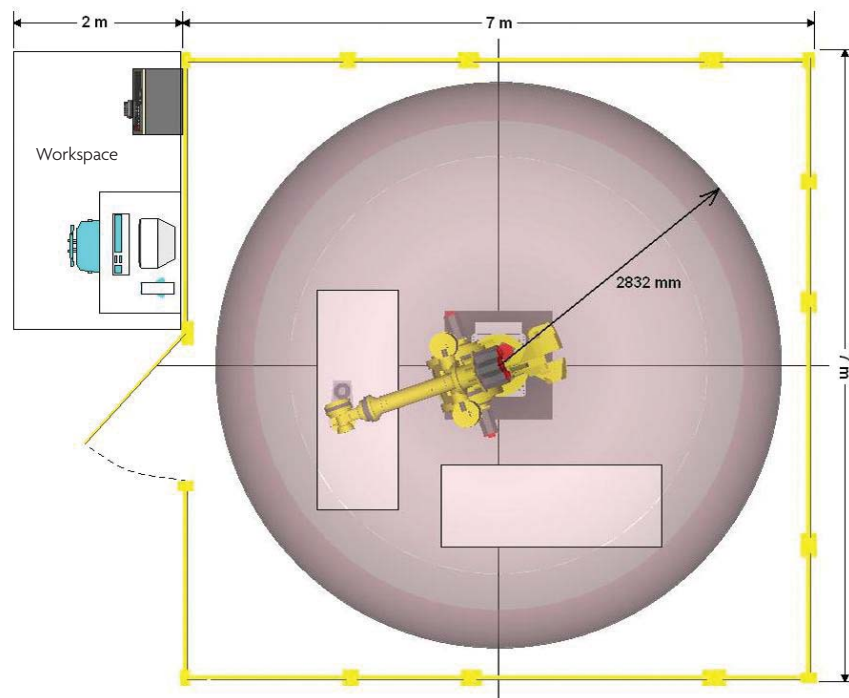
Weld head and accessories

CRIQ designed the welding head included in this system. It is powered by a *Fanuc* servo-motor fully integrated in the robot as an auxiliary axis. Effectively, this means that the welding head's rotation can be controlled through programming similarly to the rest of the robot. The motor is off-centre in relation to the spindle axis, making possible to align the tool's axis with the sixth robot axis. Drive for the welding head is ensured by a timing belt. The head contains a number of design elements enabling maximum heat dissipation for the head, preventing overheating. It is also equipped with a 6-axis force sensor that can read the amount of force exerted by the friction-stir welding process. Additional sensors can be added to the head according to application required measurements. The welding tools included with the heads are easily customizable according to the specific application. Welding head has been tested on multiple applications and mandates.



Secure work enclosure

An enclosed, secure work enclosure is included with the system. Its dimensions may vary depending on available floor space and client requirements. Inside this enclosure, the CRIQ provides slotted work benches on which a variety of welding jigs and other accessories can be assembled. The CRIQ can also design and produce welding jigs for all types of parts. The robot controller and a desktop computer connected to the latter by Ethernet are located on the outskirts of the enclosure. A remote control software is installed on this computer to enable CRIQ personnel to provide remote assistance.

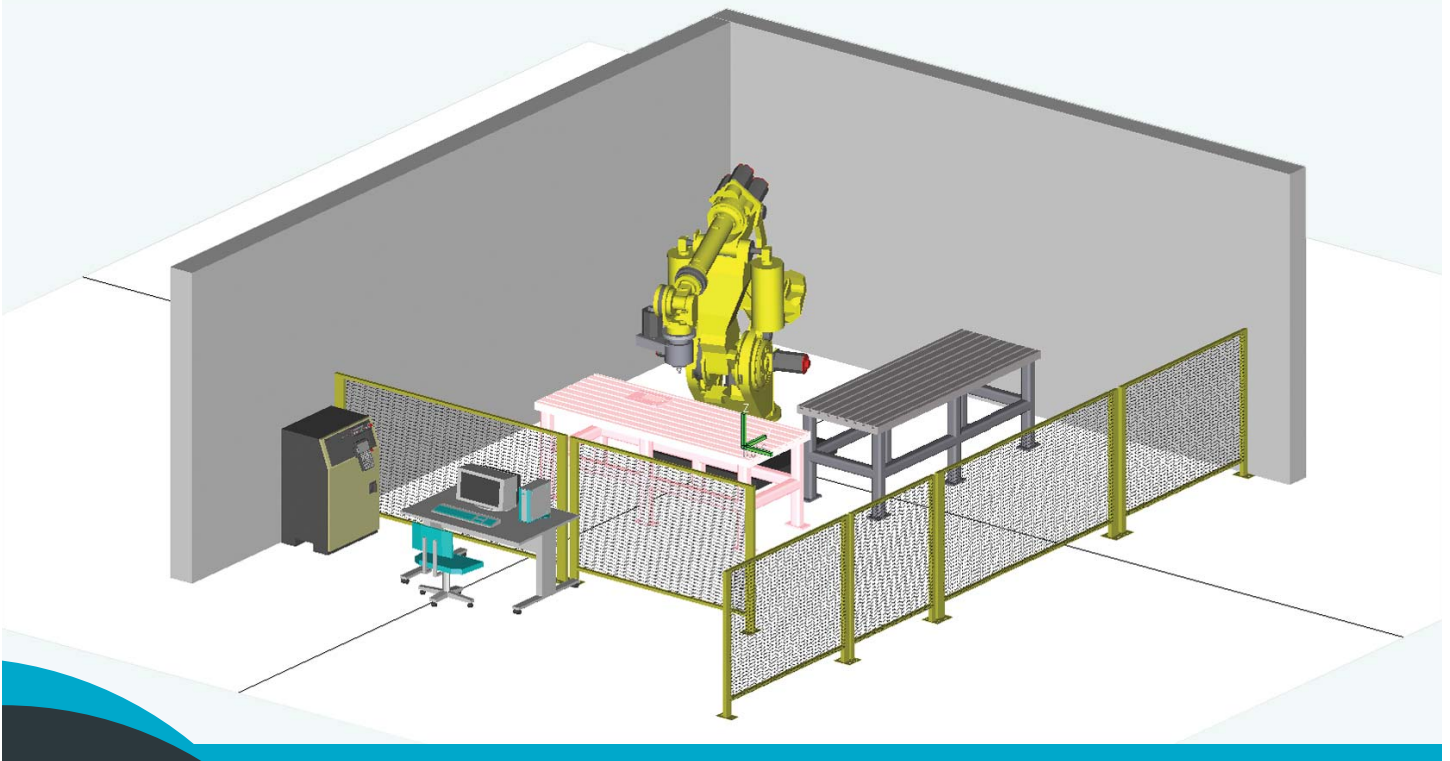


Command and control system

CRIQ's system comprises a 3D simulator and an operating interface built under *Labview*. This interface can be customized according to each application. It permits display of various data related to the system's operation in real time, such as speed, process forces and torque, correction factors applied to welding, spindle rotation speed. This interface is also used to set the given parameters for each specific weld (speed, rpm, axial speed, incline angle...) and to load the correct welding program in the controller. CRIQ provides specialized welding programs adapted to each specific application. CRIQ will also provide the necessary operational training on the system.

Robot control methods

Two different robot control methods are available for welding : force control and position control. The force control method uses data from the force sensor on the welding head to adjust axial position of the tool in real-time to ensure constant axial force. The desired force is set by the welding user before or during the welding process. Manual compensation must be made for lateral deviation of the robot caused by welding. On the other hand, position control method will follow the surface at all time, ensuring a constant position of the tool to the surface, during welding. Again manual compensation must be made for lateral deviation of the robot during welding.



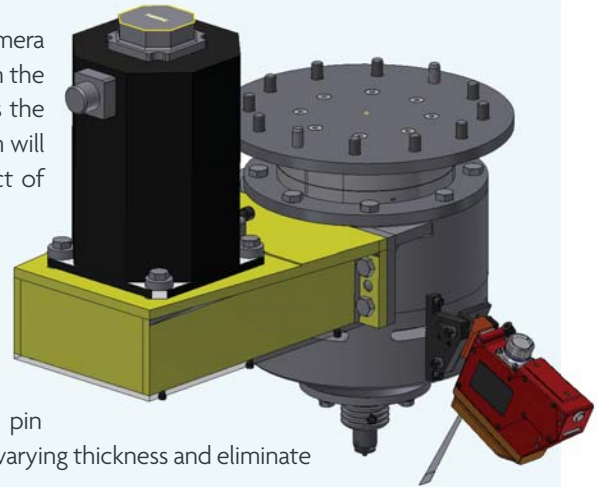
Available options

Real time seam tracking

CRIQ also offers a seam tracking sensor operating in real time using a laser camera mounted on the welding head. The system is light and efficient. It is mounted on the robot's head and linked directly to the controller. A control algorithm modifies the welding trajectory to ensure the tool is always aligned with the joint. This system will heal to automatically compensate for deviations by the robot under the effect of lateral welding forces. It works only on linear trajectories

Accessory with retractable stem

Another welding head designed and built by CRIQ is equipped with a retracting pin option. This retractable pin makes it possible to adjust the length of the pin following its insertion and during the weld process. This allows to weld plates of varying thickness and eliminate holes that would be leftover at the exit point.



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Being your partner in innovation means bringing your ideas to life, finding a concrete solution to a problem at hand, and more importantly, giving you the means to seize an entire realm of activities that are available to you in today's economic environment where borders are fading fast.



Québec 

Tel.: 418-659-1550, ext. 2250
Toll-free: 1-800-667-2386, ext. 2250
www.criq.qc.ca

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