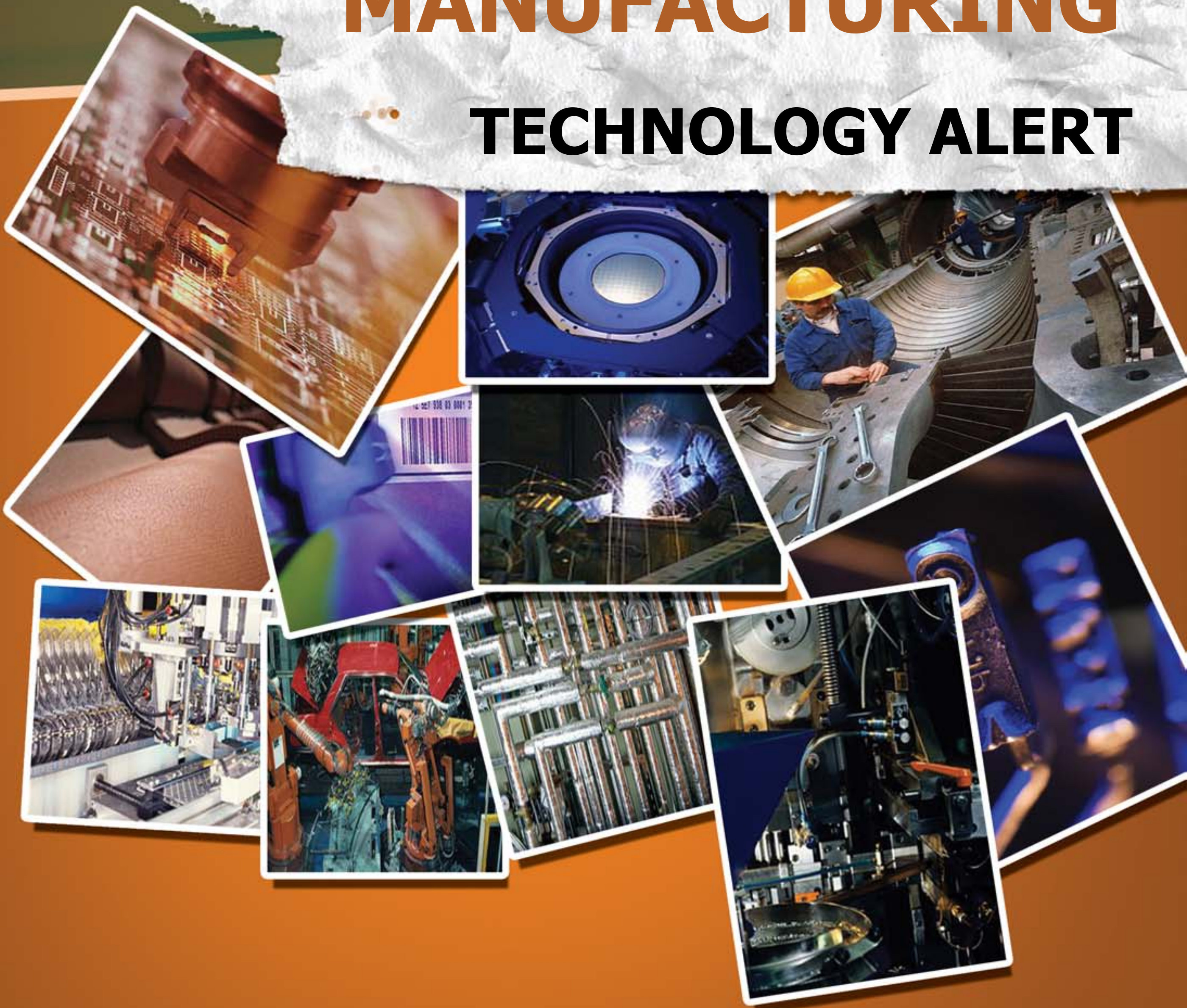
TECHNICAL INSIGHTS

ADVANCED MANUFACTURING

TECHNOLOGY ALERT



06th June 2014

1. INNOVATIVE DEVICE FOR IMPROVING CAPABILITY OF AUTOMATED GUIDED VEHICLES

Researchers from the partnering universities of the Network of Valencian Universities for the promotion of Research, Development and Innovation (RUVID) have developed an innovative low-cost device that is aimed at integration with various types of vehicles. This device allows the movement and transportation of parts and products in complex environments autonomously. According to the researchers, this system is said to be ideal for the transportation of materials, especially in warehouses where there is a need to create a continuous passage of goods between different points. The technology used in the device enables the vehicles to be programmed in a way that the vehicles can travel independently without the need of human intervention. This is done by mapping and pinpointing the area through various sensors, such as, laser, and machine vision systems. These sensors and machine vision systems allows the reconstruction of the work area and also identify moving objects within the area. The device also calculates the shortest route to reach the destination point, thereby avoiding potential obstacles through reinforcement learning techniques.

Automated guided vehicles (AGVs) are currently used in warehouse management, but the drawback seen with the current AGVs is that their operation tends to be on the paths that are established previously, which are guided by lines or lasers. These systems can have very limited flexibility and sometimes no ability to bypass unforeseen obstacles caused due to unexpected objects that might hinder the movement of vehicles. The other drawback seen with typical existing technology used in AGVs is that when there is a need to establish a new route, programming of the vehicle with the new routes is required, which in turn results in high cost and time for the company. The researchers have addressed the above-mentioned drawbacks by creating a device that helps the vehicle to adapt to the working environment rather than having to adapt the environment to the vehicle. In order to achieve this capability, researchers have developed a novel technology and also a number of patented algorithms. This technology improves the process mapping, association and location of robots compared to the conventional Simultaneous Localization and Mapping (SLAM) techniques. The technology has the capability to be adopted into any business or industrial environment where autonomous vehicles can be employed. For instance, it can be employed in management of warehouses where there are large input and output volumes, and at production centers for transporting objects between different points. In addition to the above-mentioned areas, it can also be used for the movement of goods to area, where it is difficult for humans to operate. This novel device can also be adapted into the existing conventional AGVs. The device also has a virtual reality simulator for visualizing the application of this technology for specific tasks and facilities of an individual organization. According to the researchers, they would be able to develop a comprehensive system of control for vehicles based on the specific needs of the company. This novel device for AGVs is expected to be made commercially available by 2016.

Some of the advantages of the ndevice are that it can significantly improve the capability of AGVs in addition to enhancing the flexibility. Due to the above-mentioned capabilities and advantages, this device has opportunities to be adopted on a large scale once it made commercially available.

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2. TECHNOLOGIES TO DEVELOP SELF-ASSEMBLING ROBOTS

Self-assembling robots can widen the applications for robots, including cleaning. Researchers from the Massachusetts Institute of Technology (MIT) in United States have developed two innovative technologies for creating printable robots. Using these technologies, it would be possible to assemble the parts that are produced using three-dimensional (3D) printers. With these two technologies, the researchers have demonstrated that it would be possible to print robotic components, which when heated, can automatically fold themselves into predefined 3D configurations. One of these technologies uses a digital specification of a 3D shape, such as, a computer aided design (CAD) file that generates 2D patterns that enable a piece of plastic to reproduce itself through self-folding.

The researchers have said that the other technology helps in the building of electrical components from self-folding laser cut materials. Some of these electrical components are resistors, inductors, and capacitors, as well as, sensors and actuators, which act as electromechanical muscles that enable the movements of the robots. With the development of both these technologies, the researchers have explored the technique for precisely controlling the angles at which the heated sheets fold. For instance, a sheet of polyvinyl chloride (PVC) is sandwiched between two films of rigid polyester pierced with openings having different widths, and it is heated. The PVC contracts and the openings are closed, making the edges of the polyester film press against each other, thereby deforming the PVC. The drawback seen during deformation of PVC is that, as the PVC contracts, if the opening on the top polyester film is narrower compared to the opening on the bottom film, the edges of the top opening would press against each other, but there would still be a gap between the edges of the bottom opening. This difference would make the polyester film bend in the downward direction till the bottom edges meet. The researchers addressed the above-mentioned drawback by designing the edges in a way that the result of composing the motions that interfere with each other leads to a correct geometric structure. Currently, work is being carried out to create a polyester film coated with aluminum in order to develop electronic components for robots with not only geometric properties, but also with electrical properties.

One of the advantages of the technologies is that they can be used for developing self-assembling robots. This would enable wider adoption of these robots in different market sectors and also reduce the cost of manufacturing robots. Due to the various capabilities of these two novel technologies developed by MIT, they have opportunities to be adopted for the development of robots in the future.

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3. ALGORITHM FOR MAKING ROBOTS MORE AGILE

Robotic vehicles that are capable of driving themselves have been gaining intense interest, but the adoption of these vehicles has been hindered due to a number of drawbacks. One of the key drawbacks is their capability to perform well under different working environments. The time taken to produce and interpret the data captured through the camera is one of the reasons for the above-mentioned drawback. An autonomous vehicle using a standard camera for monitoring the work environment takes about one fifth of a second to update its location, which does not give sufficient time to the autonomous vehicles to overcome an obstacle.

Researchers from Massachusetts Institute of Technology (MIT) in United States have developed algorithms and a method to overcome the limitations of the existing robotic vehicles. In this approach, the researchers have supplemented the cameras with a new type of sensor called an event-based sensor, which is capable of taking measurements a million times a second. The newly developed algorithm helps the robots to gauge their position, thereby helping them to process the data from event-based sensors. A robot working on this new algorithm would be able to accommodate its location every thousandth of a second, thereby allowing it to perform with more efficiency while carrying out quick movements. When a conventional algorithm receives an image from a robot-mounted camera, it first identifies the gradations of color or shades that it takes to be the boundaries between objects. Then it selects a subset of those features that it considers are not going to change with any new developments or perspectives. A few milliseconds later when the camera fires again, the algorithm performs the same type of analysis and starts trying to match the features between the two images. This trial and error process can take up to 50 milliseconds to 250 milliseconds, depending on the extent to which the scene has changed. Once the features are matched, the algorithm would be able to deduce the changes in position based on the distance that the robot has covered. The researchers at MIT have supplemented their algorithm for the camera's data with events reported through an event-based sensor, resulting in significant reduction in the time needed to deduce the information. In the event-based sensor, each pixel functions as an independent sensor, The pixel communicates information concerning any change in luminance that is larger than the threshold as an event. Some of the advantages of novel algorithm are that it does not identify the features individually and since the events are reported at a significantly less time, the problem of matching is also reduced. In one of the experiments, the researchers have demonstrated the novel algorithm was more accurate than the existing algorithms that are currently being employed at a large scale. The researchers are currently working on developing a more reliable control algorithm, which would help in deciding the task that has to be carried out on the basis of the stated estimates.

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4. PATENT ANALYSIS OF FLUX-CORED ARC WELDING

The process of flux-cored arc welding is similar to the gas metal arc welding process. Flux-cored arc welding employs an electrode that is tubular in shape and filled with flux. The cored electrodes used in this method produce a stable arc, which helps in improving the contour of the weld and also produces better mechanical properties. The heat generated for fusing welding the joint area of the materials is done by using a direct current (DC) electric arc. The arc produced is made to come in contact with the materials and the consumable filler wire. Shielding gas covers the entire area of the arc and protects the weld pool from the atmosphere. In flux-cored arc welding, the filler wire connected to the flux- cored wires depends on the material that is welded; usually, wires are connected to the positive or negative terminal, depending on the properties of the material used for welding. The weld quality depends on the characteristics of the output obtained from the power source. Filler wire is obtained from the spool by the wire feed unit, and it is fed to the arc at a predetermined and controlled speed through the weld gun. Specially knurled feed rolls are usually used in this process for assisting the feed and also to prevent damage to the material. Some of the advantages of this process are that the number of welding defects are significantly low, and there is no need for the use of shielding gas in this type of welding.

Title	Publication Date/Publication Number	Assignee	Inventor	Abstract
Flux-cored wire and gas-shielded arc welding method using the same	February 26, 2013/ EP 2639327 A1	Kabushiki Kaisha Kobe Seiko Sho (Kobe Steel, Ltd.)	Minoru Miyata, Reiichi Suzuki, Shun Izutani	There is provided a flux-cored wire containing flux within a stainless steel or mild steel outer cover for use in stainless steel welding and gas-shielded arc welding using a shielding gas. The flux-cored wire contains, based on the total mass of the flux-cored wire, predetermined amounts of C, Si, Mn, P, S, Cr, Ti, and O. The remainder are Fe and incidental impurities. The shielding gas is pure Ar gas.
Flux-cored welding wire for carbon steel and process for arc welding	December 21, 2012/ EP 2610361 A1	Kabushiki Kaisha Kobe Seiko Sho	Ryu Kasai, Reiichi Suzuki	Arc welding is performed with a flux-cored welding wire using pure Ar shielding gas with a pulsed current having a peak current of 340 to 540 A and a peak current time of 0.7 to 2.5 ms as a welding current, in which the wire includes a carbon-steel sheath and contains, on a mass percent basis, 0.02% to 0.15% C, 0.30% to 1.50% Si, 0.70% to 2.30% Mn, 0.010% to 0.100% S, 0.01% to 0.18% Ti, 0.030% or less P, and 0.15% or less Cr, with respect to the total mass of the wire, in which the wire has a flux content of 10.0% to 30.0%, the flux has a S content of 0.030% to 0.600%, and the wire satisfies $[S_f] > ([S_h] + 0.010)$, where $[S_f]$ represents the S content (%) of the flux, and $[S_h]$ represents the S content (%) of the sheath.
Flux cored arc welding system with high deposition rate and weld with robust impact toughness	May 10, 2012 / WO 2012153177 A1	Lincoln Global, Inc.	Sev JOHANSSON, Lisa MCFADDEN, Badri K. Narayanan	An arc welding system (100) includes a wire feeding mechanism (140) for delivering welding wire (152, 154) to a welding operation, and a welding power supply (120) for generating a current for welding to the welding wire (152, 154). The welding wire (152, 154) includes at least two distinct types of welding electrodes.
Flux-cored arc welding wire for providing superior toughness and weldability to a welded joint at a low temperature, and welded joint using same	December 27, 2011/ WO 2012091413 A3	Posco	Il-Wook HAN, Jeong-Kil Kim, Bong-Keun Lee, Hong-Kil Lee	The present invention relates to a flux-cored arc welding wire for improving the toughness and weldability of a welded joint at a low temperature, and to a welded joint using same. The present invention relates to a flux-cored arc welding wire and to a welded joint using same, wherein the flux-cored arc welding wire comprises, in weight percentages, 0.01 to 0.1% of C, 0.3 to 1.4% of Si, 1.0 to 3.0% of Mn, 4.0 to 7.5% of Ti+TiO, 0.01 to 3.0% of Ni, 0.01 to 0.2% of B, 0.02 to 0.42% of Y or 0.02 to 0.56% of REM, the remainder being Fe and unavoidable impurities.

Title	Publication Date/Publication Number	Assignee	Inventor	Abstract
Flux cored arc welding system with high deposition rate and weld with robust impact toughness	May 10, 2011/ US 20120285938 A1	Lincoln Global, Inc.	Lisa McFadden, Badri Narayanan, Sev Johansson	An arc welding system includes a wire feeding mechanism for delivering welding wire to a welding operation, and a welding power supply for generating a current for welding to the welding wire. The welding wire includes at least two distinct types of welding electrodes.
Flux-cored wire for stainless steel arc welding	November 29, 2010/ US 8492679 B2	Kobe Steel, Ltd.	Hiroshi Sugahara, Tetsunao Ikeda, Hirohisa Watanabe	A flux-cored wire for stainless steel arc welding including an outer sheath made of stainless steel and flux filled up in the outer sheath contains, as percentage to the total mass of the wire, Cr: 22.0-30.0 mass %, Ni: 6.0-12.0 mass %, Mo: 2.0-5.0 mass %, N: 0.20-0.35 mass %, TiO_2: 4.0-9.0 mass %, SiO_2: 0.1-2.0 mass %, ZrO_2: 0.5-4.0 mass %, total of Li_2O, Na_2O and K_2O: 0.50-1.50 mass %, metal fluoride in terms of fluorine amount: 0.10-0.90 mass %, and rare earth element component: 0.10-1.00 mass %, limits C to 0.04 mass % or below, W to 4.0 mass % or below, Cu to 2.0 mass % or below, Bi_2O_3 to 0.01 mass % or below, and limits oxides other than the above to 3.0 mass % or below. With such a composition, it is possible to obtain a weld bead which is excellent in the weldability in welding in all attitudes and is more excellent in the low temperature toughness while keeping excellent pitting corrosion resistance in arc welding of duplex stainless steel and the like
Stainless steel flux-cored welding wire for welding of zinc-coated steel sheet and arc welding method of zinc-coated steel sheet using same	June 26, 2009/ CA 2748188 C	Nippon Steel Corporation, Shinji Kodama, Kenichi Asai, Manabu Mizumoto, Yoshinari Ishida, Nippon Steel & Sumitomo Metal Corporation	Shinji Kodama, Kenichi Asai, Manabu Mizumoto, Yoshinari Ishida	A stainless steel flux-cored welding wire for zinc-coated steel sheet welding use which gives a weld zone where no zinc embrittlement cracking occurs and the corrosion resistance and ductility are excellent and which is good in weld work efficiency and a welding method using the same, the welding wire characterized in that total amounts of elements which are included as metals or alloy compositions in the sheath and flux are, by mass% with respect to a total mass of the welding wire, C: 0.01 to 0.05%, Si: 0.1 to 1.5%, Mn: 0.5 to 3.0%, Ni: 7.0 to 10.0%, and Cr: 26.0 to 30.0%, an F value is 30 to 50 in range, further, the wire contains, as slag forming agents, in the flux, by mass% with respect to the total mass of the wire, TiO2: 3.8 to 6.8%, SiO2: 1.8 to 3.2%, ZrO2: 1.3% or less, and Al2O3: 0.5% or less, a total amount of the slag forming agent and other slag forming agents is 7.5 to 10.5%, furthermore, the TiO2 satisfies, by mass% with respect to the total amount of slag forming agents, TiO2: 50 to 65%, and a balance of the sheath and flux is Fe and unavoidable impurities.

Title	Publication Date/Publication Number	Assignee	Inventor	Abstract
Flux cored arc weld metal joint having superior ctod in low temperature and steel member having the weld metal joint	December 23, 2008/ WO 2009082162 A3	Posco	Hong-Chul Jeong	The present invention relates to a weld metal joint subjected to flux cored arc welding (FCAW) used for weld structures, such as ships, buildings, bridges, marine structures, steel pipes, and line pipes, and a steel member having the weld metal joint, and more particularly, to a flux cored arc weld (FCAW) metal joint having excellent CTOD properties at low temperature and a steel member having the FCAW metal joint. A flux cored arc weld metal joint having excellent CTOD properties at low temperature may include, by weight: 0.01 to 0.2% C, 0.1 to 0.5% Si, 1.0 to 3.0% Mn, 0.5 to 3.0% Ni, 0.01 to 0.1% Ti, 0.0010 to 0.01% B, 0.005 to 0.05% Al, 0.003 to 0.006% N, at most 0.03% P, at most 0.03% S, 0.03 to 0.07% O, the FCAW metal joint satisfying a relation of 0.7≤Ti/O≤1.3, 6≤Ti/N≤12, 7≤O/B≤12, and 1.2≤(Ti+4B)/O≤1.9, and the balance of Fe and unavoidable impurities, the FCAW metal joint including a microstructure having acicular ferrite of 85% or more and at least one of the balance of bainite, grain boundary ferrite, and polygonal ferrite. A steel member includes the metal weld joint. According to the invention, there is provided a flux cored arc weld metal joint having a high- strength property and CTOD properties at low temperatures and a steel member having the metal weld joint.
Flux cored wire electrode for arc welding	March 27, 1997/ EP 0798070 B1	KABUSHIKI KAISHA KOBE SEIKO SHO also known as Kobe Steel Ltd.	Koichi Fujisawa plant in Kobe Steel Ltd. Hosoi, Masato Fujisawa plant in Kobe Steel Ltd. Konishi,	The present invention relates to a flux cored wire electrode filled with a titanium flux, for gas-shield arc welding; more specifically, the present invention relates to a flux cored wire electrode for arc welding, having good welding workability for all position welding, particularly for vertical position welding and overhead position welding and excellent low-temperature toughness at a temperature zone down to about -40 °C, which is frequently required for ship welding materials.
Flux cored arc welding electrode	October 5, 1993/ CA 2107706 A1	Karl J. Kulikowski, Lincoln Electric Company (The), Robert P. Munz	Karl J. Kulikowski, Robert P. Munz	FLUX CORED ARE WELDING ELECTRODE Abstract A flux cored arc welding electrode of the type used with external shielding gas wherein the electrode comprises an outer ferrous sheath and a particulate fill material compris-ing an acidic flux system and alloying agents with the fill material including an arc stabilizer, titanium dioxide, calcium fluoride, an alloying system of 0-4.0 percent by weight of electrode selected from the class consisting of aluminum, silicon, titanium, carbon and manganese. Iron powder controls the percentage of the fill of the electrode and 0.2-1.0 percent by weight of electrode is polytetxafluoro-ethylene powder.

Exhibit 1 depicts patents related to flux-cored arc welding.

Picture Credit: Frost & Sullivan

From the patents exhibited below, the recent filings indicate that the companies and universities are carrying out research to improve the flux cored wire used in this process for applications such as stainless steel welding, arc welding, and welded joints (including welded joints at low temperature).

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