What is Machine Control?
Depending upon who you ask, the answer will probably be different. In the world of construction, we tend to think of Machine Control in terms of guidance for motor graders, pavers and shovels. But if you’re a scientist, Machine Control is more about controlling sophisticated instruments. If you’re in agriculture, Machine Control is usually about land leveling and crop production. Engineers explore the boundaries of all these disciplines while users of Machine Control just assume it will work without a lot of thought behind the requirements. Is Machine Control mature or in its infancy or somewhere in between? What can we look forward to in the coming years as more technologies converge? This article will take a look at some of these obvious and not so obvious faces of Machine Control.

At a very basic level, let’s try to establish a definition for Machine Control. Obviously, there must be a Machine and some type of Control. The Machine can be large or small. It can work indoors or outdoors and by definition of the word itself, a Machine has moving parts. The Control involves sensors and software. Sensors provide inputs to the software that Controls the Machine. The inputs can be temperature, time, position, angle, pressure, speed, revolutions, etc. The software decides what to do with the inputs. It could be that updates are provided to the software on a regular basis from the sensors with resulting Controls applied to the Machine by the software. Or it could be that when a threshold is reached as indicated by the sensors, the software sends an appropriate alert to the operator or executes a Control command on the Machine. A typical example utilizing both of these techniques could be a motor grader building a road using GNSS for positioning. The GNSS receiver feeds the software a position several times per second and based on this information, the Machine can maintain proper cut/fill and left/right values in real-time. But let’s also imagine that the software requires a certain level of precision from the GNSS. If the conditions deteriorate to a point where the precision thresholds are exceeded, the operator is given a warning by the software that conditions are not suitable for continued work or the Machine is automatically disabled.

A GNSS engineer working for a company involved in manufacturing survey grade receivers will view Machine Control in regards to precise positioning of heavy equipment as they move dirt. But for a company that makes lasers, Machine Control would likely be more about pouring cement pads within tolerances of a few millimeters and other projects requiring the highest levels of vertical precision. A software engineer is going be concerned with...
drivers, graphical interfaces and ease of use across many industries simultaneously. Agriculture has progressed to a point where individual seeds and drops of water are delivered by machines to within an inch of their design location. The efficiency gains to be realized across many industries using Machine Control are proven and substantial. Therefore, the number of companies deploying Machine Control solutions is on the rise.

Many different types of construction tools use some form of Machine Control including tractors, shovels, back-hoes, motor graders, slip-form pavers, asphalt pavers, dredges, drills, compactors, etc. These faces of Machine Control are the most familiar to a construction oriented audience. Positioning is the primary sensor input.

The scientific community is no stranger to its own face of Machine Control. The Mars Rover developed by the Jet Propulsion Laboratory is a fine example of Machine Control from a scientific perspective.

Manufacturing industries also have their own face on Machine Control. Sprayers automatically paint cars as they work their way down the assembly line. Metal fabrications are bent, patterns are cut, holes are drilled and parts are tempered by software driven, manufacturing oriented Machine Control solutions.

How does an elevator know where to sit when no one is calling it? If two people on different floors press the Call button at the same time, what is the logic that decides whether it should go up or down? How does it know when it’s safe to close the door? On the service side of the elevator, are there safety mechanisms built into the software for preventing the car from stopping between floors or alerts to the maintenance department when it needs servicing? Is an elevator a legitimate face of Machine Control? I guess that depends on who you ask.

The military has been active for decades with its own faces of Machine Control. Missiles are a good early example of merging the technologies of positioning and remote control integrated with sensor inputs and controlling software. Drones that were
used for target practice likely led to the first remote controlled airplanes designed for recreational use.

The faces of Machine Control are not limited to the professional domain. Familiar examples in the consumer world include remote control airplanes and helicopters, arcade games and washing machines. Other consumer oriented items that spend much of their time in the background of our lives—but nonetheless possess the Machine Control prerequisites of software and sensors—include ice makers, garage door openers, automotive cruise controls and thermostats.

Amusement parks paint their own unique faces on Machine Control. The Disney Company for instance has an engineering department aptly named “Imagineering” devoted to creating Machine Control fantasies. Droids, [flight] simulators and robotically dancing bears are just a few examples of their work.

The drive for automation and productivity increases is addictive. What will Machine Control look like in ten or twenty years? What other industries will be affected. Have you noticed that several examples that have been cited are also integrated with remote or autonomous control? Is autonomous Machine Control the next evolution? Is it reasonable to imagine a construction site with driverless machines doing their day’s work that has been batched into a daily or weekly control file? It sounds outrageous and maybe it is. But maybe it isn’t. Look at other technology examples around us that seemed outrageous ten years ago; Facebook, VOIP (Voice Over Internet Protocol) and driverless rail systems come to mind.

Technology will continue to advance. Integration is a primary vehicle for these advancements. What other sensor inputs will be integrated into a Machine Control face? Will real-time photogrammetry techniques be integrated into safety and control systems for heavy equipment? When will voice and visual controls be included in the configurations? Remote control and automation will continue to expand their integrations into Machine Control solutions. “Connected” construction sites with WiFi coverage are today’s reality. What will augment these configurations? Real-time GoogleEarth imagery? How about “GreenTooth” technology that is not only eco-friendly, but also allows people to read each other’s mind making words un-necessary? Outrageous? Yes, probably, but only time will tell for sure.

These are exciting times to be involved with the faces of Machine Control. Change is swirling around us and we are active participants in its evolution. The construction face of Machine Control is somewhere between its infancy and full maturity. Other Machine Control faces such as the model used by elevator manufacturers are fully mature. (Or are they?) There are many efficiency and productivity gains that still remain to be exploited. Within the construction space, we are part of the evolution as we use the systems, complain about them, make suggestions for improvement and become intimate with their strengths and weaknesses. Strengths can be exploited and weaknesses can be strengthened.

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