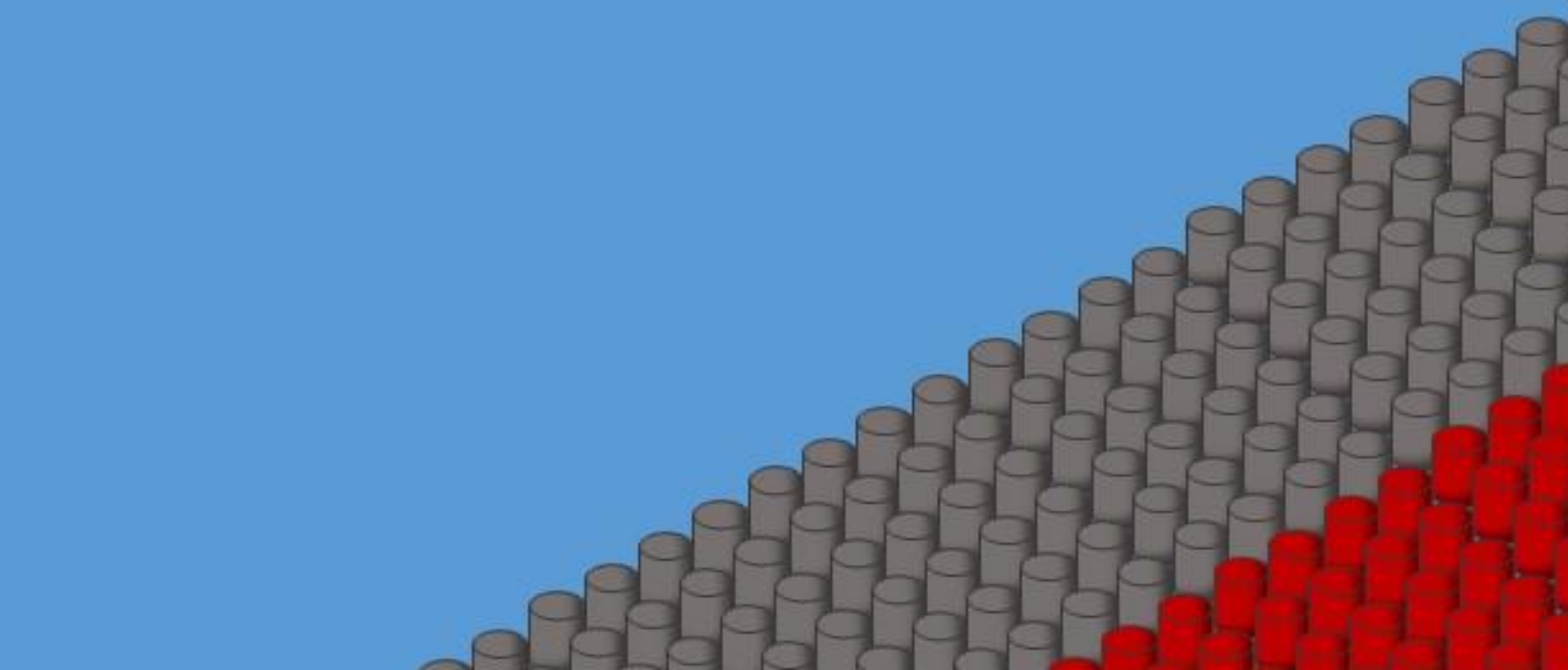
Addibots

Addibots®

Making the World a Workspace



Road Engineering with Addibots®

With endless application possibilities for Addibots, and each thus having a possible market for the technology, there are many possible directions for an initial market space for Addibots. Addibots' strengths, including mobility for AM methods, device teamwork, multiple material possibilities, and possible programmability or autonomy, among many others, will make it a competitive and desirable product in many industries. Addibots plans to focus on road engineering as an initial market place. Road engineering is a vital industry to the entire world, as it provides the backbone for a significant portion of public infrastructure everywhere. The industry is established, with many practices that could be significantly improved with the use of Addibots, and also emerging, with coming innovations accompanying the advancement of transportation technology using the roads (innovations that Addibots are perfectly poised to manufacture). As such, road engineering, although certainly not the only possible market space for Addibots, is a perfect initial market space for the technology.

At a high level, road engineering exists with three tiers of applicability for Addibots: 1) Road resurfacing and repair, 2) Road construction, and 3) Advanced roadway construction.

Road Resurfacing, Repair, and Construction

Road resurfacing and repair as a first market for Addibots may be separated into two sub-categories: preventative maintenance and emergency repair. Studies have shown[1] that routine preventive maintenance of roads not only improves the quality of roads significantly, but is also much cheaper in the long run than more-frequent tear-down and reconstruction or waiting until emergency repair is necessary. As such, a Department of Transportation (DoT) budget for road repair would ideally be used almost entirely towards preventive maintenance, with a small amount used to handle emergency repair needs caused by accidents and/or unexpected or harsh weather patterns.

With regards to road engineering, Departments of Transportation are typically limited in their activity bandwidth by budget and workforce limitations. A typical road repair job may employ 2-5 workers, depending on the exact machinery and techniques used for the job as well as the extent of the damage requiring repair. A skilled team of workers may complete multiple repair jobs in a single work day, but with a limited number of employed work teams in a given DoT, only so many jobs may be completed by these teams in a given time. This problem only gets worse with more work intensive tasks, such as constructing roads; larger teams are typically required for these more difficult tasks, further diluting the number of discrete teams mobilized from a given workforce. As a result, in many areas of the world, the amount of necessary repair and construction tasks typically exceeds the bandwidth of the workforce employed to complete them. When these tasks take too long to be completed because of a lack of bandwidth, the condition of the roads being un-repaired further deteriorates, making each task even more costly and time consuming by the time it can be resolved, thus further limiting the budget and bandwidth of the workforce; with these inefficiencies causing further inefficiencies, the positive-feedback cycle continues, resulting in a poor road quality and higher cost of repairs for a given job.

One of the main ways Addibots will solve these significant problems for firms within this market space is by allowing for a drastic improvement in their bandwidth with respect to completing repair and construction

[1] Purdue Civil Engineering study on the effectiveness of preventive maintenance
http://docs.lib.purdue.edu/cgi/viewcontent.cgi?article=1679&context=jtrp

jobs. With varying degrees of user-controllability and autonomy across various units (or across different tasks performed by a single unit) multiple units could be employed to complete the same tasks quickly and efficiently, but with a single or small number of operator(s) rather than a whole team of human workers. For example, a single team of three DoT workers conducting a single crack repair job becomes three separate teams conducting three separate crack repair jobs at the same time, and so-on for all scales of repair or construction. This multiplication of workforce numbers may be applied to separate jobs to accomplish more tasks at a single time, or to single jobs to accomplish a single task in a much shorter amount of time. As well, with the help of computer vision and mobility systems, a worker using Addibots may direct the completion of a given task with improved speed and precision, as compared to the same worker completing a given task with today's typical machinery directed by a human's eyes and hands. The resulting bandwidth and skill increase of an individual worker (and thus for a team of workers) will give firms conducting repair and construction tasks the ability to handle a significantly higher number of tasks; from this, a few things happen: repair tasks will be handled before conditions worsen and repair costs are thus increased, significant amounts of repair tasks will not go un-serviced as before, and firms will be more easily able to split available workers between necessary repair or construction tasks. Departments of Transportation will be able to better service their roads with a given budget (or complete the same tasks with a smaller budget) and private firms will yield higher profits from a significantly increased number of completed jobs.

Additionally, workers using Addibots will benefit from improved working conditions for these kind of repair jobs. Many of the materials, such as heated tar, are quite caustic to the human body and pose significant health and safety concerns. Because Addibots may be used as tools to process and apply all of these materials, workers may be separated much more easily from materials. It is also envisioned that some Addibot unit types (particularly for operation on high-speed roadways) will be larger enough for operators to sit inside of during operation. In these cases, the operator will be better protected from the dangerous traffic speeding by while they conduct repairs or construction.

Road engineering Addibots are intended to replace the equipment used by firms during additive steps of road construction or repair processes. Because many levels of operation exist for different firms, from large scale interstate highways maintained by state DoT firms, to small scale driveways maintained by smaller private firms, demand exists for machinery of varying sizes and production scales for each of these levels, at different price points for each. Addibots will be purchased in place of current machinery, at a similar depreciated cost to the replaced equipment for each level of operation. Materials used with Addibots in various road engineering tasks may be consistent with those used with replaced machinery; only the processing and additive steps executed with those materials will change. This will ensure a firm's transition from outdated tools to Addibots will not suffer from budgetary or logistical setbacks; the firm will merely benefit from the advantages of using these new additive techniques for road engineering with Addibots.

Advanced Roadways

Addibots are a significant advancement in the technology used to manufacture modern road constructions, but with ongoing advancements in smart transportation technology, including autonomous and electric vehicles, the roads themselves will also need to advance with the technology. Private and public entities alike are investing years of R&D and billions of dollars to progress in these fields, from Tesla's or Google's coming fleets of commercial driverless cars, to governments like that of the UK, who recently committed over $750M

to the development of specialized highway lanes that charge electric cars as they drive over them[2]; Addibots will be an ideal tool not only for engineering today's roads, but also for manufacturing roads consistent with these coming advancements, called 'advanced roadways' in our IP. Combining 3D printing resolution with multiple material capabilities, Addibots could easily and selectively print conductive materials into roadways for transmission of electrical power through the roads or for inductive charging capabilities like being researched in the UK, among many other uses. Addibots could also print sensors into the roadways that are powered, connected, and controlled with the printed conductive materials and that can help facilitate communication among autonomous vehicles, send more sensing data to the vehicles to help them avoid accidents, and for other framework and functionality that will be imperative for the effective operation of autonomous vehicles on the roads. Addibots could also print strengthening materials such as carbon fibers or nanotubes in specialized patterns inside of the road to provide additional structure and support at different locations along a lane.

Addibots are a perfect tool for roadway engineering projects. By applying additive manufacturing methods to repair and construction jobs for roadways, Addibots will help firms significantly improve their bandwidth to complete more jobs with lower cost, and will pave the way for future vehicles with advanced roadways.

Products

Initial Addibot products will center on a first application space of road engineering with Addibots. This first product will consist of an Addibot outfitted for tasks involved with road repair and resurfacing. These tasks will target asphalt constructions and will include dynamic crack repair, patching of larger potholes, and complete resurfacing of roads. Both manned and autonomous Addibot units will be sold, likely at slightly different price points. To help increase the possible bandwidth for handling the sheer magnitude of required road maintenance and repair projects, a higher demand will likely exist for autonomous units, although manned units will also be highly desired, to make the existing workforce more skilled in handling repair and maintenance projects, as well as to help in directing autonomous units.

Following later production of autonomous and manned units for larger scale road construction Addibots, additional types of road engineering Addibot units will be produced for different construction scales. This will include units optimized for smaller scale jobs, such as driveways or parking lots for example, to be bought by smaller contractors, etc. at a lower price point. An additional, further scaled down model will also be produced to be licensed or sold to stores, such as home improvement stores, that will rent units out to customers for daily use on smaller projects, such as driveway seal-coating or crack repair. With the production and sale or licensing of these additional models, Addibot solutions for road engineering will exist with options for all scales of possible repair or construction projects.

Addibots will eventually be produced for additional applications, with a similarly scaled approach for each application: Addibots will exist at different price points for different scales of production or repair, from industrial scales, to personal and household use. For example, within Large Object Printing (as the projected next application space for Addibots), units will be produced to be used with industrial strength materials and scales, or with commercially available materials for household use.

[2] http://www.cbsnews.com/news/england-will-test-electric-car-charging-lanes/

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