KSR INSTITUTE FOR ENGINEERING AND TECHNOLOGY

KSRIET

THE DEPARTMENT MAGAZINE

DEPARTMENT OF MECHANICAL ENGINEERING

MECHZINE

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KSR INSTITUTE FOR ENGINEERING AND TECHNOLOGY

Vision

To become a globally recognized Institution in Engineering Education, Research and Entrepreneurship.

Mission

IM1	Accomplish quality education through improved teaching learning process
IM2	Enrich technical skills with state of the art laboratories and facilities
IM3	Enhance research and entrepreneurship activities to meet the industrial and societal needs

DEPARTMENT OF MECHANICAL ENGINEERING

Vision

To produce globally recognized Mechanical Engineers and Entrepreneurs to meet the industrial challenges with ethical values.

Mission

DM1	Impart quality education in Mechanical Engineering through enhanced teaching learning process.
DM2	Provide platform to apply and analyze the engineering concepts with state of the art laboratories.
DM3	Augment the technical knowledge among students and faculty members through research activities to meet industrial and societal needs.

Program Educational Objectives (PEOs)

PEOs	Keywords	Description
PEO1	**Core Competency**	Graduates will adopt technological changes in core and allied areas of Mechanical Engineering.
PEO2	**Professionalism**	Graduates will have leadership quality with soft skills to excel in their professional career.
PEO3	**Higher Studies and Entrepreneurship**	Graduates will evoke interest in higher education and develop entrepreneurial attitude for ever changing industrial and societal environment.

Volume 4 Issue 1

MECHZINE

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Radiofrequency: An Update on Latest Innovations

S. Aswin Kumar, II Year, Department of Mechanical Engineering, KSRIET

As the aging population in our society continues to increase, many people are seeking technologies and treatments to help achieve a more youthful appearance. This, coupled with the general population's busy lifestyle, is leading towards a desire for procedures with minimal side effects and little to no recovery time. Of the skin rejuvenation modalities, radiofrequency (RF) has emerged as a safe and effective treatment for a broad range of aesthetic and medical indications.1-4

Radiofrequency emits focused electromagnetic waves which meets resistance within the tissue, generating heat.5 This thermal energy affects collagen's triple helix structure, subsequently breaking the intramolecular hydrogen bonds resulting in immediate collagen contracture and subsequent neocollagenesis within the dermis without disrupting the epidermis.6-8 This results in further collagen tightening and an overall increase in collagen content.9 A study by el-Domyanti et al10 shows that RF further decreases elastotic material in the upper dermis and induces reorientation of elastic fibers within the papillary and upper reticular dermis. Unabsorbed by melanin, RF is chromophore independent allowing it to be safely used for all skin types.11 RF is associated with few complications and adverse effects while allowing a quick recovery time.12-14

RF devices vary based on the number of electrodes, dividing them into unipolar, bipolar and multipolar devices. Unipolar devices have a single electrode with a grounding pad. The highest concentration of electrical energy, and consequently heat, remains near the tip of the electrode and decreases distally.15 This type of device results in the deepest tissue penetration resulting in the highest efficacy,5 though it is accompanied with significant discomfort16,17 Unipolar devices have shown significant improvements in skin tightening and laxity, rhytids, brow elevation and both active and scarring acne lesions.9,10,13,16,18-21 Furthermore, the use of a mobile device for the delivery of unipolar radiofrequency in a split face study has shown a trend toward improvement of rhytides and laxity of facial skin.

Bipolar devices consist of two electrodes, without a grounding pad, emitting a fast, alternating current.15 The controlled energy distribution decreases the discomfort associated with older devices.22-24 The main limitation of this device is that the treated area is limited to the volume between the two electrodes25 with the depth of penetration being approximately half the distance between the two electrodes

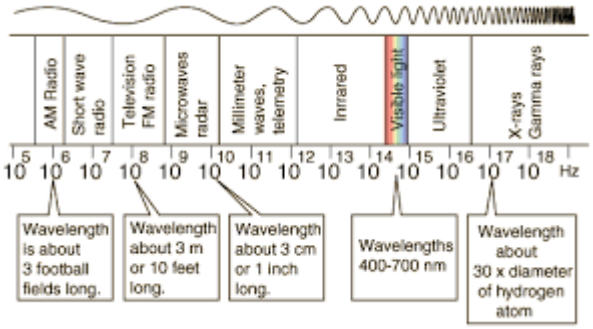
Lastly, multipolar devices work similarly to the bipolar ones but consist of three or more electrodes. One electrode maintains a positive charge while the others carry negative charges. Electrodes alternate between positive and negative charges to

avoid overheating.15 These devices allow a larger volume to be heated with less discomfort, although only superficial areas are treated

A myriad of studies have been conducted expanding indications for the use of radiofrequency devices and discovering the underlying mechanisms resulting in their efficacy. Identifying

the mechanisms involved in exhibiting results allows clinicians to identify new uses. One such identified use, which has shown promising results in daily practice, is for postpartum skin laxity. RF induced skin tightening would be efficacious for this particular indication. This tightening and lifting effect on skin results from the preferential heating of collagen-based fibrous septa leading to contraction of subcutaneous tissue.1,27

Another indication, although lacking significant clinical studies, is the treatment of aging hands. Based on the author's personal clinical experience, RF improves the aesthetic appearance of the dorsal surface of the hands. RF reduces skin laxity and increases dermal collagen, which is believed to reduce the visibility of superficial veins in the hand.6,7,28,29 A novel, first-of-its-kind, study utilizing three treatments of unipolar RF at two week intervals resulted in 50% visual improvement based on an improvement of at least one point on the Global Aesthetic Improvement Scale.



Cellulite, a common aesthetic concern among patients may also be improved utilizing RF treatments. Theoretically, the higher electric conductivity of septa compared with adipose tissue allows electric charge to flow through septa preferentially. This results in a change in configuration of the septa, targeting adipocytes for thermal injury.15 Unipolar RF has been used to treat grade III and IV cellulite on the upper thigh in 30 patients.33,55,56 A total of six treatments were performed at two week intervals. A significant decrease in the appearance of cellulite resulted in a mean decrease in thigh circumference of 2.45 centimeters (cm). Dermal fibrosis, reported on histology, results in long lasting effects. Sadick et al34 noted improvements in the appearance of cellulite in 100% of patients, whereas Alster et al35 noted clinical improvement in 90% of treated patients.

Computing Power and Sensors Strengthen Rural Electric Grids

R. Deepak, II Year, Department of Mechanical Engineering, KSRIET

The U.S. Department of Energy is committed to closing that gap and has earmarked nearly $10 million to support research that will advance and expand nationwide service, building a more resilient power grid for everyone. As part of this, the agency has invested $1.6 million into a project at The University of Texas at Austin's Center for Electromechanics (CEM) that's working to improve real-time grid monitoring systems, using sensor technologies and in-the-field data gathering.

The massive U.S. power grid is made up of nearly 160,000 miles of high-voltage power lines, millions more miles of low-voltage lines, and more than 7,300 power plants. The network connects and provides power for some 145 million American customers.

The network also gets smarter every year. Innovations such as renewable power sources, solar photovoltaics and advanced new energy storage systems are bringing the power of distributed energy resources to the modern grid, turning the legacy network from a one-way delivery system into a two-way street for the flow of electricity. For consumers, these advancements can mean everything from lower energy costs, to cleaner power to reduced greenhouse gas emissions.

Despite the size of the U.S. electric grid, not all Americans benefit from it, especially those living in rural areas.
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The new system uses sensors which monitor the environment to keep energy running in rural areas.

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But not everyone in the U.S. has access to these advancements.

Chain Reaction

M. Dhayanidhi, II Year, Department of Mechanical Engineering, KSRIET

Designers used 3D printing to consolidate 855 parts into 12, saved more than 100 pounds in weight, improved fuel burn up to 20 percent, added 10 percent more power, and simplified maintenance on its new turboprop engine. Engine image: GE Aviation

Additive manufacturing, also known as 3-D printing, is a win-win for people who restore classic cars and the companies that made them.

Take for example the Porsche 959, the world's fastest street car when introduced in 1987. Only 292 were ever made and spare parts are either scarce or nonexistent.

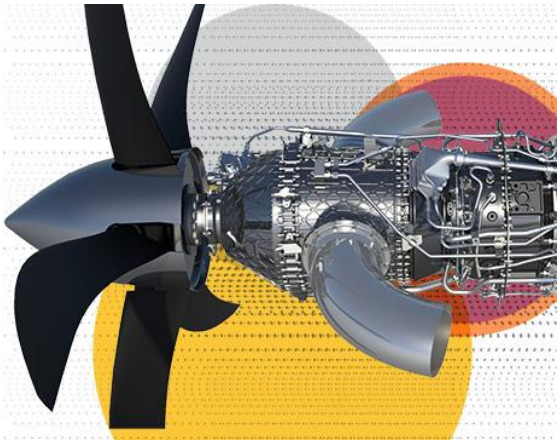
When inventories ran out, Porsche would pull out old tooling and make a small batch for future use. This year, however, Porsche announced it would begin scanning several parts into CAD models and print them on demand, a faster and less costly process.

Porsche is not the only automaker doing this. Mercedes-Benz makes 30 additive spares parts for older Daimler trucks. And Volvo has introduced some parts as well.

These parts mark the auto industry's first tentative steps in using additive industrial pump or motor might have scores of parts, a car 30,000, and a jetliner 3 to 4 million.

Manufacturers must make spare parts for all of them. So, they make extras during production, when tooling is in place and manufacturing to fill its supply chain. They certainly won't be the last.

While additive manufacturing is usually the most expensive way to make any part, it makes economic sense for supply chains. Which is why manufacturers of everything from aircraft and rolling stock to appliances, industrial equipment, and medical devices are looking at 3-D supply chain solutions—as are the U.S. Marines and UPS.



Today's global supply chains begin with raw materials and parts used to build products and extend to the distribution and storage of spare parts for service. They vary in length and complexity. An

parts cost less to manufacture. Then they go into inventory.

Some parts, like bearings, motor windings, and brake pads, are always in demand. They return their initial investment quickly. Others stay in storage for decades

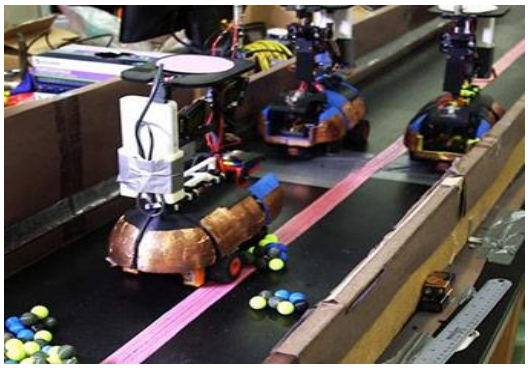
on end. In fact, logistics giant DHL believes excess and rarely used stock may sometimes total more than 20 percent of all inventory. That's expensive.

Additive manufacturing promises to address those problems and more. Additive can make parts to order from digital files that cost pennies to store on servers. It can also consolidate multiple parts and fasteners into a handful to integrated structures that simplify sourcing.

Robots Programmed to Work Like Ants Get Job Done

K. Pravinth, III year, Department of Mechanical Engineering, KSRIET

Robots have long borrowed from nature for locomotion. They flylike bees, run like cheetahs, and bounce like galagos. But as they advance and begin to work more closely together on certain tasks, robots will have to imitate nature's industrious strategies as well, especially if we want them to perform as efficiently as possible.



Only a certain number of robots work effectively in a narrow horizontal tunnel. Image: Georgia Tech

For instance, a swarm of robots expected to quickly dig a tunnel will need to know the ant method for staying out of each other's way.

Daniel Goldman, a professor of physics who runs the Complex Rheology and Biomechanics Lab (or Crab Lab) at the Georgia Institute of Technology noticed that even though ant tunnels are extremely narrow, they never get choked up with too many workers.

"We wanted to know what they do when they're digging, how they decide how to dig if there's no central leader," Goldman said.

To find out, the team gathered 30 fire ants, put dots of different colors on their abdomens, placed them in a container of wet glass particles, and watched them dig. The team presented its results in a recent issue of *Science*.

The ants didn't play tag team, work in alternating groups, or take turns in any other fashion. In fact, their strategy was quite simple: A handful of the ants (about 30 percent) did the work while the majority did nothing.

"Very few were doing any of the labor," Goldman said. "Over 48 hours, with a group of thirty ants, half never came to the tunnel."

When his team removed the five hardest working ants, five more stepped up to the plate to carry on the digging.

The strategy of minority servitude served the ants so well that Goldman decided to try it on a group of robots.

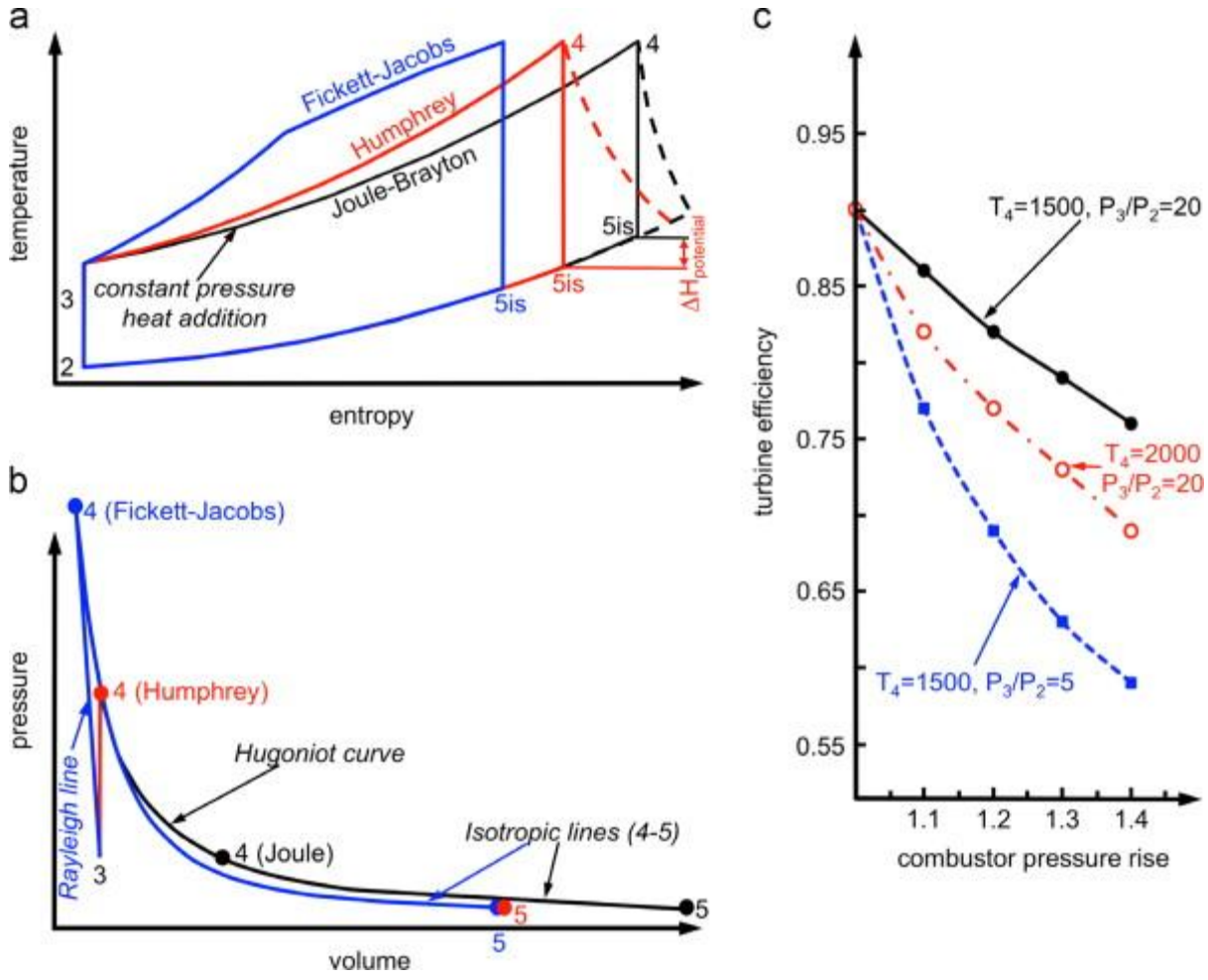
The robots, essentially oblong shells on wheels, resembled armadillos more than ants. Researchers placed them in a narrow channel with plastic balls on one end that served as the soil. The robots would roll over to the balls with the intention of grabbing them, moving them, and releasing them with their gator-like jaws. Push switches on their shells would alert them to the presence of their fellow workers.

Design and analysis of pioneering high supersonic axial turbines

M. Navaneethakrishnan, III Year, Department of Mechanical Engineering, KSRIET

The thermal efficiency of advanced combined cycles surpasses 62.8%, considering a turbine entry temperature of 1703 K [1]. However, the maximum possible efficiency offered by the Carnot cycle for the same firing temperature would be 82.8%. While further increase in pressure ratios and firing temperature gradually enhance the cycle efficiency, novel turbine-based thermal plants offer a potential leap in efficiency. In particular, the Humphrey and Ficket–Jacobs cycles provide a rise of pressure through the combustion process. Fig. 1a and b display the entropy–enthalpy and pressure–volume charts of the ideal Joule–Brayton (constant pressure heat addition), the Humphrey, and the Ficket–Jacobs cycles. The Humphrey cycle is based on constant volume heat addition with an isentropic expansion and an isobaric heat rejection. In the Fickett–Jacobs cycle, the combustion is an explosive process, utilized in the 1920s in a Hozwarth turbine [2], or using perhaps a special piston-cylinder arrangement, that in practice results in supersonic flow conditions at the combustor exit. A multitude of research teams have suggested the use of pressure gain combustion for power plants [3]. The use of a constant volume combustor, displayed in red in Fig. 1a and b, allows achieving the same time-averaged combustor exit temperature at a higher-pressure level (the turbine inlet temperature T_4 is fixed by the current material technology). Conversely, to achieve the same turbine inlet conditions of a Joule cycle, the Humphrey cycle requires less pressure increase in the compressor. Consequently, the Humphrey cycle offers a potential surge in specific power and cycle efficiency. Nevertheless to achieve the potential gain in such pioneering power plant, the turbine efficiency should be above a certain threshold dictated by the combustor pressure rise and turbine entry temperature. Let us consider that the Joule engine is equipped with a 90% efficiency turbine, Fig. 1c demonstrates that the required efficiency of the turbine in the Humphrey cycle to achieve the same cycle efficiency than the Joule cycle, decreases a function of the combustor pressure rise. Humphrey cycles operating at large turbine entry temperatures, with low

compression ratio require low turbine efficiencies. For instance, in a Humphrey cycle with T_4 =1500 K, P_3/P_2=5, with a combustor pressure rise of 40%, a turbine with an isentropic efficiency of 59% would extract the same work than a 90% efficiency turbine in a Joule cycle.



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