**Miin J. Yan, PhD, PE**

**Experiences and Education**

Dr. Miin J. Yan, inventor of the D-Cycle™ (Differential-Stroke Cycle) technology, is a co-founder and the CTO of Yan Engines, Inc, and is the Principal Investigator of a DOE SBIR Phase II project to retrofit existing heavy diesel engines in military vehicles with the D-Piston™ design for substantial fuel efficiency and propulsion improvements.

Yan Engines, under his guidance, has developed a D-Cycle™ 50cc scooter engine with data indicating average 82% mpg and 203% propulsion gains (at same horsepower) from its retrofit baseline 125cc scooter engine in preliminary (uncertified) laboratory tests. His previous experiences include the technical leadership on the HEV (Hybrid Electric Vehicle) engine when working for DaimlerChrysler.

Earlier, he had worked on aircraft engines and nuclear reactors after PhD (and Master of Arts as bonus) from Princeton University, Aerospace and Mechanical Sciences. His parents moved from PengHu to Kaohsiung where he was born (1940), attended Kaohsiung MS/HS and National Taiwan University, Civil Engineering before coming to US.

**His photo:**



**D-cycle™ (Differential-stroke cycle) Technology for Next Generations of Engines**

By Miin J. Yan, PhD, PE

Current 1.5-century old engine technology wastes not only fuel energy but also structural weight/size. The gasoline V6 for cars or the diesel inline-6 for semi-trucks has only half of the engine (3-cylinders) driving the vehicle at all time, as an example. Moreover, the driving half cylinders don’t even output full load all the time. The fuel efficiency and the power density are very poor. D-cycle™ makes all cylinders driving at all time and also allows engine volume adaptive to output needs. Thus, it not only greatly improves the fuel efficiency, but also greatly enhances the power output besides reducing cost and emission. I will discuss some technical issues - and show moving models.

**Short Bio**

Miin-Jeng Yan (QANi' MINp`JENGp in Taiwanese) is a co-founder and the CTO of the Yan Engines, who has a contract to retrofit military heavy diesels with the D-Piston™ (differential-stroke piston) technology - for fuel efficiency and propulsion improvements. Yan Engines has also developed a D-Cycle™ (differential-stroke cycle) 50cc scooter engine for the market, to replace current 4-cycle 125cc scooters which had replaced the popular 2-cycle 50cc scooters. Earlier he led the HEV (Hybrid Electric Vehicle) diesel engines development for Chrysler in DDC/DaimlerChrysler; and worked on aircraft engines in GE and nuclear reactors after his PhD.

He graduated from Kaohsiung HS (1959) and NTU (BS Civil Eng’g 1963) where he served as a TA for 2 years after military service and came to US in 1966. He got a MS (1968 Penn State) and a PhD (1972 Aerospace and Mech Eng’gs plus MA) from Princeton.

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**Abstract:**

**D-cycle™ (Differential-Stroke Cycle) Engine Technology**

**By Miin Jeng Yan, PhD, PE of Yan Engines, Inc**

Current engines are of the vintage 4-stroke or 2-stroke cycle technologies. After 1.5 centuries of continuous improvement by thousands of engine experts and through billions of productions, the technology has reached the point of diminishing returns. Available means for fuel efficiency and GHG reduction may achieve some improvements but at a very stiff cost for all – OEMs, owners, customers, and the economy - involved.

The conventional one-piece piston design has the following primordial flaws.

* It seals the combustion chamber AND transmits cylinder loads with the crankshaft;
* It pumps full intake during duty-cycle (part-load) operations;
* It uses identical stroke displacements and periods for different thermodynamic functions in power/exhaust/intake/compression; and
* It ties the engine (torque) output to the piston stroke volume. 

Yan Engines Inc has patented the D-cycle™ which is a hybrid of 4-stroke and 2-stroke cycles. It is by a simple split 2-piece piston design as shown in the attached Figure. The split piston has the crown part to seal the chamber and the skirt part to transmit forces. The crown part makes the lighter exhaust and intake strokes by a (valvetrain-like) pistontrain mechanism, such as a robotic arm, on the piston lever (horizontal extension in the Figure). The 2 parts combine to make the heavy compression and power strokes via the con-rod as in the conventional piston. The stroke displacements and periods are optimized for different thermodynamic functions and for different duty-cycle loads and during engine operations.

D-cycle has all cylinders working like a 2-cycle while having clean gas exchange like a 4-cycle. Current i4, v6, and v8 car engines can be downsized to i2, i3, and i4, respectively, and achieving higher output (due to reduced friction and inertia) at lower costs and higher fuel efficiency. The fuel efficiency is achieved by lower RPM, optimized strokes, lighter weight, lower inertia, and fewer parts for friction reduction.

The engine provides needed peak load and performs duty-cycle work. To achieve great fuel efficiency in real-life applications, it is imperative to adaptive the sweet-spot efficiency to duty-cycle operations. The split 2-part piston enables the downsized strokes to adapt to the duty-cycle loads for optimal engine operations to significantly improve the real-life fuel efficiency, not just the sweet-spot operation. The technology can be retrofitted into existing engines in service, or better retrofitted into current 4-cycle engine design for production, or best yet incorporated in the clean-sheet new engine design for optimal gains of the new technology.

Yan Engines has an ongoing work to retrofit heavy diesel (i6) engines to demonstrate fuel efficiency, emission, and propulsion improvements. Earlier completed retrofit of the split piston technology into commercial scooter single-cylinder engine prototypes has indicated, via preliminary test, potential of 81% MPG improvement with 203% torque gain. Somewhat comparable improvements for said HD engine work are expected. When wholly implemented with robotic arm and electronic engine control on the piston strokes, more than doubled MPG can logically be expected.

The presentation will discuss issues associated with the technology and its business and commercial potentials.