Pulsed Power

- It is the science of releasing stored energy in a short duration leading to very high instantaneous power.
- Here at USC, we design application specific pulse generators to deliver high voltage pulses that are < 100 ns wide and have very short rise times (~10ns).

Our Pulse Generators

The ability to deliver short pulses depends greatly on the types of switches used. At the Pulsed Power Research Group and in collaboration with Transient Plasma Systems Ltd, we’ve designed as well as built pulse generators for various applications:

- Thyatron based Pulse Generator: This pulser uses a thyatron switch to deliver 30 kV pulses into a 50 Ohm load.
  - Pulse Rise Time: 50 ns
  - Peak Instantaneous Power: 500 kW

- Magnetic Pulse Compression based Pulse Generator: These pulsed (Fig. 1) are based on a technology that makes use of stages of saturable inductors followed by a junction recovery diode to achieve very short rise times.

- Low Energy Compact Pulses: Designed and built for use in Transient Plasma Ignition research, these pulsed (Fig. 2) use Pseudospark and solid state switches to deliver 365 mJ and 75 mJ respectively into a 200 Ohm load.

Applications

- **Emissions Treatment from Diesel Engines:**
  - Short nanosecond pulses are being used in an ongoing effort to study the effect of non thermal plasma on diesel exhaust.
  - Non thermal plasma is known to effectively remediate NOx, SOx and PM from engine exhaust.

- **Biological Applications:**
  - Application of nanosecond pulses induces apoptosis or programmed cell death showing great potential for cancer therapy and application of even shorter pulses was shown to be useful for targeted drug delivery.

  - **Plasma Accelerator Research**
    - The principal application for the work at USC, however, is plasma-based wakefield accelerators (PWFA), demonstrating potential as a novel method for charged particle acceleration that could boost incoming beam energy over short distances.

  - **Transient Plasma Ignition**
    - Transient plasma generated by nanosecond pulses was used to initiate combustion of air- CH4 mix.
    - It demonstrated significant advantages over conventional ignition: shorter ignition delay, lean burn capability and better efficiency and reduced emissions.

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