Michael Smith

Source detailing

1. Acoustic Health Monitoring of Suspension Bridge Main Cables

<http://www.puretechltd.com/pdf/technical_papers/2002/PTL_Technical_Paper_20080212160835.pdf>

* Visual inspection of 10ft length of cable, wedged down at 5in at 8 points along the circumference: exposes only one side of 4000 linear ft of wire, or 0.007% of total length.
* Wire breaks are high frequency acoustic emissions that travel up and down wire.\
* Two structures with permanent, wired setups:
  + Bear Mountain Bridge, Peekskill NY
  + Bronx Whirestone Bridge, NYC NY
* Lessons learned from BWB:
  + Ambient noise is filterable
  + Detecting of wire cuts was successful to -0.7m to 0.0m, average was 0.15m
* Lessons learned from BMB:
  + Some sensors were on spreaders (where wire splits to anchor) and could detect/locate the specific strand that broke
  + Hardwiring sensors to main cable is challenging and costly
* Temporary Project:
  + Wireless system that used power scavenging
  + Wireless communication preformed continuously without interference
  + Number of sensors is less than wired

1. Practical Continuous Acoustic Monitoring of Suspension Bridge Cables

<http://www.puretechltd.com/pdf/technical_papers/1999/PTL_Technical_Paper_20080212161424.pdf>

* Cable deterioration and breakage stems from corrosion and stress corrosion
* These deteriorations are nonlinear and increase with time
* Current exposure processes can cost in the order of 2 million dollars to expose inspect and reinstate 320ft of cable
* Developmental Length: distance over which a break has an effect on the strain of the wire, tightness of cable band has significant effect
* The impact of the development length of the structure is simply that the maximum number of breaks that can be tolerated in any section of the cable must also include all of the breaks within the development length.
* Bronx Whitestone Instillation
  + System used broadband accelerometers at 6 consecutive cable bands & a DAQ
* Cable snaps were large enough acoustic event to differentiate between other events such as traffic and construction (construction had similar intensity but featured different spectrum)
* Cable events appeared over a period of around 100ml, considerations for “pre-event” time were added to this time
* Events were broad spectrum extending over 20kHz
* Determined Nyquist frequency of 40k samples/sec or more
* Used 12 bit A/D converter, found suitable
* Sensor frequency response was over 20kHz and sample at 44,100 s/sec
* Up-time was clse to 97% and could hear 100% of the snaps

1. LONG-TERM STRUCTURAL HEALTH MONITORING SYSTEM OF A CABLE-STAYED BRIDGE BASED ON WIRELESS SMART SENSOR NETWORKS AND ENERGY HARVESTING TECHNIQUES

<http://sstl.cee.uiuc.edu/papers/Park20105WCSCM.pdf>

* Created wireless SHM system that used energy harvesting
* Test bed was the 2nd Jingo cable stayed bridge in South Korea
* Used Crossbow Imote2 sensor package:
  + Imote2: smart wireless sensor
  + Multi-scale sensing board
  + Battery board with three 1.5V batteries
  + Link to imote2’s datasheet & tinyOS page:
    - <http://wsn.cse.wustl.edu/images/e/e3/Imote2_Datasheet.pdf>
    - <http://tinyos.stanford.edu/tinyos-wiki/index.php/Imote2>
* Created a software toolsuite to control and acquire sensing data.
* Sensor development featured 70 sensors deployed on cables, split into two groups of 35 due to transmission range limitations
* Features modal analysis of the bridge
* Used solar panels and small wind turbine to harvest engery
* Found that a small turbine was a viable source of energy with 18.6mW of max power produced