White Paper for the NSF workshop

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Current work

Over the past two years, my group has been studying body area networks to measure and model physiological signals and efficiently represent them. We have been able to show that using physics-based modeling of ECG signals, efficient computational models can be developed for long-term unobtrusive monitoring of the physiological signals. We were also able to recently show that similar to ECG, even EKG and PPG signals can be modeled efficiently so that long-term unobtrusive monitoring is feasible for these signals.

In addition to signal modeling, we were able to show that given a set of body sensor networks, it is possible to develop an optimization framework that allows priority based efficient polling policies that enable sensor data from each device is gathered while meeting clinical requirements.

My interest in bio-networks area

At present I am interested in two problems that I consider important to be understood.

Task related alertness via physiological signals—I am primarily interested in understanding how the physiological signals can allow us to model the degree of alertness of a person. As task related performance is related to physiological alertness, I am curious to study and find if one can develop mathematical and analytical models to directly infer task related alertness from physiological signals themselves. From what I have seen in the literature, at present, the task related alertness is measured via subjective approaches that rely on self-reporting of alertness, rest period and time between rest period.

Computing control points in the presence of noise—Noise is everywhere in biology and is something that every organism seems to be living with. Biological systems have been shown to be viewable as networks where control nodes can be used to provide external inputs. Finding network nodes that can serve as external control inputs in the presence of noise will help us to understand how cells as well as more complex biological networks can be controlled.

References

1. Sidharth Nabar, Ayan Banerjee, Sandeep Gupta and Radha Poovendran , Resource-efficient and Reliable Long Term Wireless Monitoring of the Photoplethysmographic Signal, to appear in Wireless Health 2011.

2. Sidharth Nabar, Ayan Banerjee, Sandeep Gupta and Radha Poovendran,*GeM-REM: Generative Model-driven Resource-efficient ECG Monitoring in Body Sensor Networks*, in proceedings of Body Sensor Networks (BSN '11), May 2011.
3. Sidharth Nabar, Ayan Banerjee, Sandeep Gupta and Radha Poovendran, *Evaluation of Body Sensor Network Platforms: A Design Space and Benchmarking Analysis*, Wireless Health Conference (WH'10), October 2010. **Please also see BSNBench Software Tool**

4. Sidharth Nabar, Jeffrey Walling and Radha Poovendran, *Minimizing Energy Consumption in Body Sensor Networks via Convex Optimization*, International Conference on Body Sensor Networks, June 2010.