

Dr. Kong's research interests include product design planning, design strategy, and end user driven innovative design.

- (a) **Design strategy and design planning study.** Dr. Kong established a mathematical model by combining design structure matrix (DSM), decision theory and Hilbert Simon's rationality principle to quantitatively answer for the first time questions for a given complex design task, under what organizational structure a task process can achieve the highest efficiency, ideal quality, lowest cost, and the best innovation opportunity (Henry Mintzberg's Ad-hocrocy).
- (b) **Product design rationalization study:** Dr. Kong built a mathematical model by using DSM methodology to characterize a product by its underlying structure expressed by correlated relationships among design parameters in order to determine for each parameter its most rational value with complete consideration of how others affecting it. Dr. Kong used this model to successfully guide the practical design of in-hub motor and alleviating pressure cushion.
- (c) **Product environment design:** In this study, product, environment and human factors are simultaneously parameterized by using regrouping technology in the DSM methodology. The sets of parameters which define product functions are determined by considering the impact from both environment and the user. This study is typically useful in designing patient environment, hospital and other community facilities, etc.

2. My R&D interests fall in end user driven innovation design

Applying multidisciplinary engineering, science, new tech and new material to design/invent new products in healthcare and rehabilitation industries. As illustration, as main planner or team member Dr. Kong has been enrolled in the following projects:

- (a) **Alleviating Pressure Cushion (APC):** Funded by the U.S. Department of Education (NIDRR). The Alleviating Pressure Cushion (APC) can reduce pressure at the interface between buttock and cushion, therefore reducing the risk of pressure ulcers. The APC systematically integrates vacuum, automatic control, noise suppression and other technologies. Other interest with this topic is cushion micro climate control, i.e. adjusting the moisture and temperature of the seating cushion.
- (b) **In-hub motor and next generation of power wheel chair chassis design:** The in-hub motor is the integration of a pancake shaped rare-earth (NdFeB) high speed DC motor, gearing, brake, lock and suspension. A controller, designed specifically for use with this motor, has been configured for joystick and tiller interfaces. By integrating in-hub motor, a kind of low cost (comparable to the cost of a bicycle), repair and maintenance free, one mode cast wheelchair chassis to target the group of users who need mobility assistance in their daily life but are not covered by medical insurance.
- (c) **Occupancy switch:** This is a powerless occupancy switch Dr. Kong designed/invented to reliably monitor and detect whether patient or disabled people occupy the wheelchair or not. This is important for the study of wheelchair users' daily lives and their safety.

(d) Wound measurement device: Developing a portable, low cost wound measurement device which absolutely measures the size and depth of a wound. This technology would completely replace the ruler which is right now universally applied in hospital.

3. Design by applying micro-manufacturing technology for biomedical engineering

(a) Miniaturized, low cost, multi-spectral imaging instrumentation: This biomedical imaging instrument is funded by NIH grant. Instead of using traditional filters or methods of dispersing light, a novel custom filter mosaic has been successfully designed and fabricated using lithography and vacuum multi layer film technologies. The filter has been integrated with CMOS and CCD image sensor chips. This is the first-ever system to realize production of real time, narrow band multispectral images from a single miniaturized imaging sensor. Several well-known American media outlets reported this breakthrough, e.g.

http://www.laserfocusworld.com/display_article/350987/12/none/none/WebX/MULTISPECTRAL-IMAGING:-CMOS-imager-with-mosaic-filter-detects-skin-disorder

This is the most important step in bringing multispectral imaging technology to practical application in clinical practice and other fields.

(b) Customized applications in biomedical engineering: Now that Dr. Kong' group has achieved major breakthrough in the core technologies for fabricating handheld multi-spectral imaging devices and the filter micro manufacturing process has been established, my priorities are **(1)** to develop a handheld quantum dot detector for cancer study and targeted drug delivery and **(2)** to reconstruct the **Hartman** interferometer by integrating the narrow band multi spectral filter and miniaturized microscope technology to introduce to it new functions including **(i)** simultaneously inspecting multi viruses **(ii)** concentration monitoring in real time. These will enhance the capacity of versatile integrated optic sensor in their practical application for label-free, real-time quantification of nucleic acids, proteins, and pathogens and the detection of bird flu, swine flu, pandemic virus and food poisoning bacteria.