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PROJECT LIST

1. Demulsification of Oil-in-Water Emulsions using Superhydrophobic Graphene Oxide Coated Sand
2. Smart Pavement Crack Detection and Repair
3. Development of Shear Connection System for Concrete Filled GFRP Tubular Structures
4. Automatic Cleaning of Solar Photovoltaic Panels: PV and CPV

MONASH University
MALAYSIA

DEMULSIFICATION OF OIL-IN-WATER EMULSIONS USING SUPERHYDROPHOBIC GRAPHENE OXIDE COATED SAND

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The presence of oil emulsions in wastewater due to industry processes, particularly in the oil and gas industry, must be removed to conform to discharge permit limits. Due to their stability in water, various technologies have been studied to seek for highly efficient, rapid, universal and low-cost demulsification materials to separate oil-in-water emulsions. With the discovery of superhydrophobic graphene oxide with a contact angle up to 152°, this project aims at synthesizing superhydrophobic GO coated sand as a means for oil-in-water emulsion separation through filtration. Following the synthesis, this project would include further characterization tests of the superhydrophobic GO coated sand, including SEM, TGA, XRD, Raman spectra and AFM. The novel superhydrophobic GO coated sand would then be tested in a laboratory scale column filtration to remove synthetically prepared oil-in-water emulsions. Finally, the recovery and regeneration of the superhydrophobic GO coated sand would be tested and observed. This research is expected to provide a promising, simple, highly efficient and universal demulsifier to separate oil from oil-in-water emulsions at ambient conditions, which can be applied in most industries.

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SMART PAVEMENT CRACK DETECTION AND REPAIR

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Pavement surface crack is a very common distress for urban streets and highways. The timely repair for cracks is important to prevent water intruding into pavement to damage road structure. Current practice in the detection of pavement crack is usually visual-based and the repair is conducted manually. Our goal in this project is to develop a platform to detect and repair pavement cracks in an automatic manner. Compared to current practice, such platform is more reliable, more efficient, lower traffic disruption and safer. The platform is composed of three parts: the detection system, the repair system, and the operation system linking the two. In detail, the automatic crack detection is achieved via pavement surface imaging by camera and image processing based on grayscale difference between cracks and regular parts. Then the detailed geometrical information of the cracks (i.e. coordinates and width) are imported into the operation system, which will give orders to the repair system to feed sealing materials into the cracks automatically. No physical labour is related in the whole process except for the vehicle driving. The first year goal is to establish a demo platform which can prove the feasibility of the larger scale platforms. The second year goal is to create lab scaled platform for both the detection and repair. At the end of the third year, the research team aims to establish field scale machines which can directly work on real pavement

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DEVELOPMENT OF SHEAR CONNECTION SYSTEM FOR CONCRETE FILLED GFRP TUBULAR STRUCTURES

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Pultruded glass fiber reinforced polymer (GFRP) has low shear-to-compressive strength ratio due to the glass fiber orientation used in the manufacturing process. Young's modulus and compressive strength of pultruded GFRP sections are lower in the transverse direction that those in the longitudinal direction. These characteristics resulted in localized failure when pultruded GFRP hollow sections subjected to concentrated loads in the transverse direction. Concrete infill is effective in preventing localized failure and the shear and bending moment capacities will improve significantly if the full composite action can be achieved. However, the slippage at the concrete-GFRP interface solely relying on the chemical bonding of concrete hinders the development of full composite action. The commonly used coarse sand coating technique for concrete-GFRP composite structures is not suitable due to the limited access to the internal surfaces of the tubular structures. Furthermore, no mechanical shear connector is available for concrete-GFRP tubular structures. This study aims to develop an effective shear connection system through finite element analyses and experimental studies. The experimental program includes push out tests and three point bending tests at various shear span to depth ratios. Numerical and analytical models will be developed to predict the shear and moment capacities of concrete filled GFRP tubular structures using the proposed shear connection system. It is expected that the full composite action can be achieved by using the proposed shear connection system.

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AUTOMATIC CLEANING OF SOLAR PHOTOVOLTAIC PANELS: PV AND CPV

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Solar photovoltaic panels accumulate dust, dirt, bird droppings, dry leaves and other particles that reduce the solar radiation reaching them. This, in turn, reduces the efficiency of the solar panels. Therefore, regular pro-active actions for cleaning and maintenance are required. The traditional way of cleaning involves manual cleaning using water jets. Automatic cleaning mechanism can ensure higher reliability with reduced cost. In literature, automatic cleaning has been addressed by electrical, mechanical, chemical and electrostatic methods independently. Mobile robots can be designed for automatic cleaning to move on the surface either autonomously or through remote control while scrubbing, vacuuming or using water jets to clean the panels. In this project, we propose the conceptual design and usage of multiple collaborative mobile robots as an integrated cyber-physical system to autonomously clean a large installation of solar panels (solar farms) of various configurations such as photo-voltaic (PV) and condensed photo-voltaic (CPV) (disc type). The robots will coordinate among themselves to inspect and clean the surface as and when required. For recharging and replenishing cleaning material, the robots will reach the nearest docking station. The problem is to coordinate the motion of the robots for efficient power generation by monitoring functionality and cleanliness

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