Environmental and Aerosol Transmission of COVID-19
Monday 26th April 2021 to Wednesday 28th April 2021
Via Zoom

Poster Session - Tuesday 27th April – 12.40 – 13.30

Presenters: Lidia Cantero Garcia, Saket Kapse, Muneeb Khawar, Ayman Mohammed, Dena Rahman, Rishav Raj, Maham Sandhu and Taylor Smith
Title: Novel Air Filter to Suppress Viral Load in Confined Space

Abstract: The effects of the COVID-19 pandemic are currently being felt around the world. Till now, it has caused the death of more than 3.1 million people worldwide. Aerosol transmission mainly occurs in confined spaces such as hospitals, offices, restaurants, and places of worship. Thus, the idea came about to develop an air filter which would be able to effectively eliminate the airborne pathogens and make the confined spaces safer for the public to access.

Presenter: Sibo Cheng (Imperial College London)
Title: Optimal Vaccination Strategies for COVID-19 Based on Dynamical Social Networks with Real-Time Updating

Abstract: Vaccination strategy is crucial in fighting against the COVID-19 pandemic. Since the supply is limited, contact network-based interventions can be most powerful to set an optimal strategy by identifying high-risk individuals or communities. How- ever, due to the high dimension, only partial and noisy network information can be available in practice, especially for dynamical systems where the contact networks are highly time-variant. Furthermore, numerous mutations of SARS-CoV-2 impact considerably the current infectious probability, requiring real-time network updating algorithms. In this study, we propose a sequential network updating approach based on data assimilation techniques to combine different sources of temporal in- formation. We then prioritise the individuals with high-degree or high-centrality, obtained from the assimilated networks, for vaccination. The assimilation-based approach is compared with the standard method (based on partially observed net- works) and a random selection strategy in terms of vaccination effectiveness in a SIR model. The numerical comparison is first carried out using real-world face-to-face dynamical networks collected in a high school, following by sequential multi-layer networks, generated relying on the Barabasi-Albert model emulating the department of Computing at Imperial College London in the UK as an example.

Presenter: Valerio D'Alessandro (Imperial College London)
Title: Modelling of cough droplets diffusion in relation to SARS- CoV-2 transmission

Abstract: We present the main the results of our ongoing work related to CFD modelling of cough droplets diffusion. The effect of ultraviolet-C light biological inactivation is also taken into account.

Presenter: Ulrich Dobramysl (University of Cambridge)
Title: Mean Time to Infection by Small Diffusing Droplets Containing SARS-CoV-2 During Close Social Contacts

Abstract: We investigated the time until infection occurs with SARS-CoV-2 during close contacts with an infected person, in a variety of settings, distances, mask wearing and ventilation conditions. This is a numerical simulation study, which describes viral droplets as diffusing particles. Our findings imply that the mean time to infection increases roughly linearly with the inter-person distance, mask wearing

increases the time until infection occurs. Ventilation plays a crucial role, effectively dispersing viral droplets and reducing the probability of infection.

Presenter: Pablo Garcia-Trinanes (*University of Greenwich*) Ali Mokhber (*University of Greenwich*)
Title: LOPA vs COVID

Abstract: The Layers of Protection Analysis (LOPA) is widely used in chemical process industries to design the plant protection systems. This method considers an initiating event, namely a process mishap leading to catastrophic failures, then examines the requirements of independent protection devices to mitigate the risk. This methodology is applied to COVID transmission as an initiating event and then independent protection layers such as Social Distancing, Ventilation, hand hygiene etc, to mitigate the fatality.

Presenter: Angus Grandison (*The University of Greenwich*)
Title: Modelling Capability to Predict COVID-19 Infection Risk

Abstract: FSEG have coupled CFD aerosol dispersion analysis, the Wells-Riley model and dynamic movement to provide a modelling capability to predict COVID-19 infection risk and support mitigation analysis within complex environments e.g., trains, aircraft, recirculating HVAC in buildings. Preliminary results produce good agreement with real events and experimental studies, suggesting the approach may be useful for assessing and managing risk in diverse indoor settings

Presenter: Shuo Mi (Queen Mary University of London)
Title: Inactivation Effect of Human Thermal Plume and Upper-Room Ultraviolet Air Disinfection on The Covid-19 Transmission

Abstract: The project aims to study the inactivation effect of human thermal plume and upper-room ultraviolet air disinfection on the COVID-19 transmission. CFD (computational fluid mechanics) method is pursued to simulate the human thermal plume and DEM (discrete element method) is coupled to account for the movement of COVID-19 virus particles. The numerical model shows that half of the virus particles could be inactivated by upper-room ultraviolet air disinfection during 12 minutes in small unventilated office without ceiling fan assistance and 70% of the virus particles would be inactivated in half an hour. Ceiling fan is expected to much accelerate the inactivation and is under investigation.

Presenter: Philip Nadler (Imperial College London)
Title: Data Assimilation for Parameter Estimation in Compartmental Models

Abstract: Being able to understand and forecast epidemic developments is crucial for policymakers. We develop a custom compartmental SIR model fit to variables related to the available data of the pandemic, named SITR model, which allows for estimates of transmissibility rates and on infection numbers. We compare and discuss model results which conducts updates as new observations become available.
We furthermore develop a predictive model combining epidemiological dynamics of compartmental models with highly non-linear interactions learned by a LSTM Network. A novel dynamic SIR model is fit to variables related to the population transmission of Covid-19. This is embedded in a Data Assimilation framework which is then coupled with a LSTM network to forecast cases of Covid-19. The model improves forecasts over simple univariate LSTM or SIR models. We apply the model to developed and developing countries and forecast confirmed infections and analyse future trajectories.

Presenter: Avshalom Offner (University of Edinburgh)
Title: Dynamics of Respiratory Saliva Droplets

Abstract: We theoretically study the dynamics of respiratory saliva droplet as they travel through air while vaporising. Our model is governed by a set of ordinary differential equations (ODEs) for the droplet position, velocity, radius and temperature, reflecting the conservation of momentum (Maxey-Riley model), mass and energy, respectively. For small Reynolds number droplets, the ODEs for the radius and temperature can be decoupled from the others, allowing analytic approximations to be derived for the terminal droplet radius as well as for the time until this radius is reached. To numerically solve the full system of ODEs, a model for the air velocity is required. Attempting to provide sensible estimates on the droplet airborne time before touching the ground, we simplify the model by considering a one-dimensional problem (aligned with gravity), in which an indoor vertical air velocity is described using an Ornstein–Uhlenbeck process.

The model results suggest that saliva droplets can stay aloft for up to several hours. Droplets typically shrink to their terminal radius in about 1-10 seconds, during which they may fall a considerable distance depending on their initial size. Having reached their terminal radius, droplets are almost fully entrained with the air flow. Air velocity fluctuations result in non-negligible probability of droplets rising above their original height. In practice, this means that people within indoor spaces may inhale infectious droplets by passing through a location previously occupied by a person carrying the virus. These results may assist in shaping and adjusting social-distancing guidelines, as well as affect regulation on the allowed number of people within indoor spaces.

Presenter: Thomas Woolley (*Cardiff University*)
Title: A General Computational Framework for COVID-19 Modelling, with Applications to Testing Varied Interventions in Education Environments

Abstract: We construct a compartmental individual-based model of the spread of Covid-19. The model can be used to predict the infection rates in a variety of locations when various interventions are introduced. Tasked by the Welsh Government, we apply the model to secondary schools and Further and Higher Education environments. Specifically, we consider student populations mixing in a classroom and in halls of residence. We focused on assessing the potential efficacy of Lateral Flow Devices (LFDs) when used in broad-based screens for asymptomatic infection or in 'test-to-release' scenarios in which individuals who have been exposed to infection are released from isolation. LFDs are also compared to other non-pharmaceutical interventions; we find that, although testing can be used to reduce the spread of Covid-19, it is more effective to invest in personal protective equipment (e.g. masks) and in increasing ventilation quality in indoor spaces

Presenter: Xiaofei Wu (Imperial College London
Title: Modelling the spread of SARS-CoV2 virus in hospital: Initial results

Abstract: The aim of this computational study is to simulate how the virus spreads in a patient room with the computational fluid dynamics (CFD) model Fluidity, developed by Imperial College. Fluidity is an open source large eddy simulation (LES) model with an advanced adaptive mesh. Firstly, this study will connect the numerical simulation with virus measurement to validate the simulation result. And then, the study will focus on effect of ventilation, such as the location of supply and extract and the air exchange rate on the virus spreading in a hospital, which could suggest how to build up an environment in which the staff working will be least susceptible to be infected. However, the study is ongoing and only some initial results will be shown at current stage.
In addition, the poster also contains an interesting topic from Prof. Fan Chung: Is SARS-CoV-2 airborne and does it interact with particle pollutants, including the study objective, the deliverables and the study design.