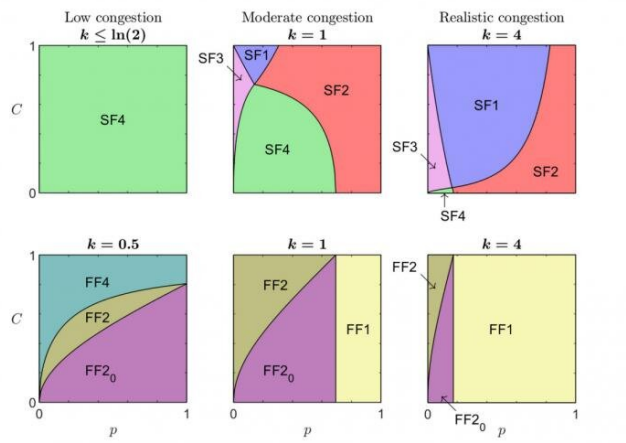
General relativity used to find optimal airplane boarding speed

22 January 2020, by Bob Yirka



How noodles' mechanical properties control the way they soften. Credit: APS Journals

A team of researchers from Western Norway University of Applied Sciences, Riga Technical University and Ben-Gurion University has created a mathematical model that can be used to predict boarding times for airplanes based on the boarding speed of individual passengers. In their paper published in the journal *Physical Review E*, the group describes using Lorentzian geometry to create their model, and what it showed.

Prior research has shown that it is difficult to predict boarding times for passengers on airplanes due to the large number of factors involved. Some people move faster than average, some slower. Some have more luggage to stow in the overhead bin. And some have early boarding passes that give preferential treatment. In this new effort, the researchers sought to create a model that could give boarding times for a given number of passengers under predefined conditions, such as each passenger having the same amount of luggage to put in an overhead bin.

To attack the problem, the researchers used Lorentzian geometry, which is the mathematical foundation of Einstein's general theory of relativity. It allows for making connections between very small moving particles with macroscopic properties. In this case, passengers stood in for the particles and the macroscopic property was the amount of time it took an individual to sit down in their assigned seat.

The researchers note that with passenger boarding, delays are the central issue. Any of the passengers can slow the progress of any other passenger. And those delays, they found, can also be impacted by a given passenger's position in the queue and by the location of their assigned seat. The model they created ran in iterative steps with passengers moving either until they found their seat or become blocked by another passenger. A second step factored in the time spent by passengers putting their luggage in an overhead bin.

Running the model showed that the most efficient way to board passengers on an airplane is to allow those who move the slowest to board first. The researchers claim that doing so is 28 percent more efficient than random order boarding—and the results were the same regardless of the ratio of slow passengers.

More information: Sveinung Erland et al. Lorentzian-geometry-based analysis of airplane boarding policies highlights "slow passengers first" as better, *Physical Review E* (2019). DOI: 10.1103/PhysRevE.100.062313

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