EXOPLANETS

Neural networks filling the gaps

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Only a minority of the more than 4,000 discovered exoplanets are fully characterized, even in their most basic properties. For example, less than 1,000 planets have an estimate of the minimum mass (the true mass is much rarer, because you usually need the orbital inclination). Elizabeth Tasker and collaborators demonstrate how machine learning can help fill these gaps.

Tasker et al. use a neural network that they train with a set of 400 exoplanets for which six observables, chosen by the authors, are known: radius, mass, orbital period, stellar mass, equilibrium temperature and number of (known) planets in the system. The network employs the joint distribution of these properties to predict a distribution of values for the missing parameters in incomplete datasets. A test on a benchmark of 150 exoplanets, which were fed to the system without their (known) mass, showed that the network could retrieve the correct mass within a factor of 1.48 for the systems discovered via radial velocity, for which there is an indication of the minimum mass, and within a factor of 2.7 for the transiting exoplanets, which don't have any mass constraint. A similar exercise for the radius returned an average error of a factor of 1.4.

The method of Tasker et al. already has a similar or better performance than other techniques currently used to infer exoplanetary masses, with the advantage that it is agnostic with respect to any observational or empirical correlation. In addition, future observations will allow the inclusion of additional observables and an increase in the number of exoplanets in the training set, improving the accuracy of the network's predictions.

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