The matrix methods in the stability theory of stellar systems and the problem of bar formation

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Until recently the Kalnajs matrix method has been the only general method for theoretical investigations of the stability of disk-like stellar systems. Here we propose an alternative method of finding unstable modes of stellar systems. It is a substantial advantage of the new approach that the unknown oscillation frequencies are obtained from a linear eigenvalue problem. This greatly simplifies the search for solutions and provides additional possibilities to study physical phenomena underlying the instability of stellar systems. We also discuss a mechanism of galactic bar formation in stellar disks where a bar-mode is interpreted as a density wave in the disk of stellar orbits. Numerical experiments of disks with slowly increasing rotation curves show that normal bars originate from the most unstable spiral mode of the stellar disk with a single maximum.