China Accomplished Vertical Rocket Landing at Sea
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China recently successful tested the vertical landing of a rocket at sea.

Developers from the Chinese Academy of Sciences said the technology will lay the foundation for future applications such as a reusable near-space (50…80 miles) experimentation platform and the development of space travel.
CAS-Space, a commercial space company partly owned by Chinese Academy of Science (CAS), announced in April 2023 the successful land-to-sea landing flight test in Haiyang, East China's Shandong Province, during which the recovery of the rocket stage at sea, communications and technology for tracking and guiding spacecraft under the influence of sea conditions were reviewed.
According to the CAS-Institute for Mechanics, the developers also examined the flight environment during the final landing and checked the touch-down accuracy on the unsteady landing area on the sea.
The rocket prototype reached an altitude of more than 1000 meters then started smoothly sinking down, decelerating thanks to the thrust reversal of the engine. The landing speed was reduced to less than 2 m/sec in the final phase before the missile touched down with a landing accuracy of less than 10 m.
The whole test lasted about 10 minutes, the CAS-institute declared upon completion.

Lian Jie, the institute's chief engineer, said in an exclusive interview in late May, that the 2.1-meter-long and 0.5-meter-diameter rocket prototype weighed 93 kg at launch and was powered by two engines, each with a thrust of 550 Newton. During the test, a turbocharged engine was used to simulate the use of a variable-thrust liquid rocket engine during the vertical landing phase.

According to the developers the complete success of the vertical landing laid the foundation for future technological development for applications such as platforms for scientific experiments on suborbital trajectories, the recovery of rocket stages and for space tourism.
The first flight of a scientific experimentation platform in a near space trajectory could take place as early as the end of 2023, Lian explained. This type of rocket recovery technology would be widely applied to future rocket models, including the Lijian-3 and the Lijian-3 heavy lift rockets, and contribute to the future of China’s space exploration on a larger scale with substantial cost reductions.

Wu Weiping, also senior engineer at CAS-Space, explained the prospects for future human spaceflight applications, pointing out that passengers inside a suitable capsule would experience zero gravity for three to seven minutes at an altitude of about 100 km above the Earth.
Such spaceflight opportunities would respond to the public's desire to experience the adventure going

to space, and such a ‘space shuttle’ would also collect valuable data for future space exploration and space tourism, Wu added.

In April 2016, the US company SpaceX achieved the first successful seaborne recovery of the main rocket stage of its two-stage Falcon 9 on the drone ship ‘Of Course I Still Love You’(OCISLY), after four previous attempts ended in the destruction of the booster on impact.

When asked how CAS' seaborne rocket stage recovery differs from SpaceX's, Lian explained: “Our technology is based on native software and hardware, and we explore technological thresholds such as variable thrust management, precision positioning and stabilization technology on our own”.

Pang Zhihao, a leading space expert from Beijing, stressed that landing the rocket stage at sea could significantly reduce the cost for a launch, as the landing ship could be moved to meet the incoming stage. “A land recovery could save the fuel the rocket would have to expend to fly to the pre-defined landing site, which could mean a loss of about 40% of the rocket's payload capacity, compared to just 20% for a sea recovery, because more fuel is needed for targeting the pre-defined site for land recovery” Pang explained, “although the recovery at sea would be very difficult due to the complicated conditions on sea but sea landings could also help to avoid impact damage in the event of landing failures”.

As a historical side note, it should be mentioned that the dream of recovering a rocket after ascent existed from the very beginning of ‘rocketry’ and was promoted by the German rocket pioneer *Hermann Oberth* in his 1923 book *“The Rocket into Planetary Space”*:

Place of Decent: Although my rocket appears to ascend vertically, it does not fall back to the same place from which it lifted off. First, it is influenced by laterally moving air layers (the horizontal component of their movement is nearly equal to the lateral movement of the higher air layers). Second, a deviation comes about for cosmic reasons. Due to the rotation of Earth, the rocket moves under a great circle drawn around the celestial sphere as observed from the intersection of the plumb line with Earth’s axis. Initially, this circle runs exactly from west to east, but later deviates towards the equator, unless the launch site itself lies on the equator. Furthermore, the angular velocity of the rocket referenced to the center of Earth is less than the angular velocity of the point on the surface of Earth over which the rocket is currently located. This causes a deviation to the west. In Fig. 9 [see original text], the arrow connects the geographical points over which the rocket flies. This curve can be easily calculated. Thereby, recovery can be facilitated. ([3], page 32)

References:

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