Developed under the joint YuRom programme, the IAR-93/Orao emerged as a punchy, if uncomplicated, attacker in the mould of the Anglo-French Jaguar. Its continued development was cut short by the tumultuous events which occurred in the countries which created it.

IAR-93 and Orao

Balkan Warrior

Prior to World War II, Romania had developed a self-sufficient aviation industry. During the war it produced more than 1,300 aircraft, of which 450 were IAR-80 and IAR-81 fighters and dive-bombers, delivered by Industria Aeronáutica Romana (IAR) in Brasov. They fought on three fronts: in the Eastern campaign against the Soviet Union; in the defence of the oil refineries around Ploiesti, against Allied bombers; and in the Western campaign, for the last nine months of the war, on the Allied side and against the Germans. Despite this late shift of allegiance, the peace treaty did not accord Romania co-belligerency status and the country was forbidden to produce combat aircraft after the war.

Right: This model shows the IAR 91 design proposed by the Romanians for the Yurom fighter. The intended powerplant was two non-afterburning RD-9Bs. Two guns were mounted on the sides of the nose and four hardpoints were provided.

Facilities were set up or retained for the overhaul of Soviet types newly entered into service, as well as workshops for small-scale production of light aircraft and gliders. Although IAR in Brasov no longer existed, 'IAR' remained the trademark of several aircraft designed and/or built in Romania during that period and afterwards (and was even adopted as a local designation for licence-built aircraft).

In the 1960s Romania began to detach itself from the influence of the Soviet Union, even

though it was a member of the Eastern Bloc and remained Communist. This became more evident after 1965 when Nicolae Ceausescu became the new leader. Within the general reorganisation of the country's economy, it was decided in September 1968 to develop a

Above: The unpainted, canopy-less Romanian prototype undergoes final checks with IRAv at Bacau. The fuselage mark served as an sighting aid for centre of gravity measurements.

Left: Romania's IAR-93 prototype (001) first flew on 31 October 1974. The Soviet-style star national insignia gave way to roundels in 1984.

Left: Today the IAR-93/Orao remains in service only in Yugoslavia (Serbia) and the Bosnian Serb Republic, an unknown number having escaped the NATO onslaught during Allied Force operations in 1999. This quartet of IJ-22 Orao 1s is seen prior to the conflict.

modern aviation industry by co-operating with countries outside the Eastern Bloc, especially those from western Europe.

A special institute for research and design in the aeronautical field was set up in Bucharest in 1968 as ICPAS (Institutul de Cercetari si Proiectari Aerospatiale - Aerospace Research and Design Institute), which in 1970 became IMFCA (Institutul de Mecánica Fluidelor si Constructii Aerospatiale - The Institute for Fluid Mechanics and Aerospace Construction) and later INCHEST. Within the nucleus of the design team was a group of engineers from URA (later IRAv) in Bacàu, led by Dipl. Eng. Theodor Zanfirescu. At URA the team had performed the initial design of the IAR-90 business jet, followed by the IAR-91 and IAR-92 combat aircraft projects.

The first important project from ICPAS was to be a combat aircraft, designed in co-operation with VTI (Vazcluhoplovno Tehnicki Institut - Aeronautical Technical Institute) from Zarkovo, near Belgrade in Yugoslavia. Militarily, Yugoslavia was the ideal partner for such a programme - it was not a member of the Warsaw Pact, it was near Romania and had similar industrial potential and military needs.

It had become apparent that a combat aircraft was needed to equip Romanian fighter-bomber units, and the requirements were for a subsonic multi-role aircraft capable of acting as a fighter against subsonic aircraft and cruise missiles, and of undertaking air combat and ground attack missions. The specification for the joint Romanian/Yugoslav aircraft was quickly defined by military specialists from the two countries during a meeting in Belgrade between 10 and 20 December 1969, and a close air support aircraft was stipulated.

Design work started in 1970 and on 20 May 1971 the two countries signed a governmental agreement for the YuRom project. The first programme managers were Dipl. Eng. Teodor Zanfirescu for the Romanian party and Colonel Vidoje Knezevic for the Yugoslavs.

The Romanians proposed the IAR-91 design, which had RD-9B turbojets for the powerplant and a general layout similar to that of the Sukhoi Su-25 (which was under development at that time). Agreement was finally reached on the Yugoslav proposal, which had several similarities with the Jaguar and featured Rolls-Royce Vipers.

It was decided that the aircraft would be named IAR-93 in Romania and J-22 Orao (Eagle) in Yugoslavia (J came from *jurisnik* = close support fighter).

Construction begins

The construction of a single-seat prototype started in each country in May 1972. IRAv (today Aerostar SA) in Bacàu was the main contractor and was responsible for fuselage construction, general assembly and testing of the Romanian prototype; IRMA Baneasa (today Romaero SA) in Bucharest built the wings, and ICA Ghimbav-Brasov produced the control surfaces. The construction of the Yugoslav prototype took place at the factories in Mostar (SOKO), Pancevo (UTVA) and Trstenik. Within the framework of the YuRom programme, Romania was responsible for the forward fuselage, fin and auxiliary tanks, and Yugoslavia for the wings, aft fuselage and tailplane.

Above and right: 25001 was the Yugoslav prototype, completed without gun armament. It is shown above at Batajnica with four rocket pods. In Romania the IAR-93 remained a closely-guarded secret until the early 1980s, whereas the Orao prototype was shown at the Yugoslav Air Force Day display at Batajnica on 15 April 1975. The first Orao was placed on display in the Yugoslav Aeronautical Musuem at Surcin.

The selected powerplant was two Rolls-Royce Viper Mk 632-4IR turbojets with a maximum thrust of 4,000 Ib (17.79 kN) each, installed side-by-side in the aft fuselage. The turbojet was to be built under Rolls-Royce licence in both countries. In Romania, the newly founded Turbomecanica in Bucharest was awarded the production licence; for the Yugoslav aircraft, the Orao factory at Rajlovac, near Sarajevo, was selected.

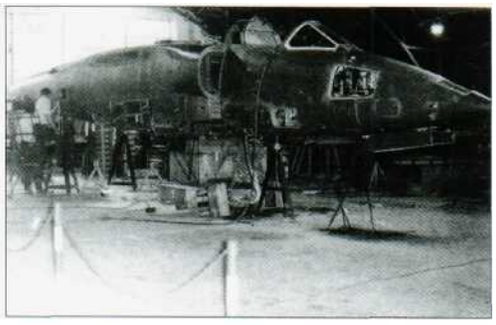
Prototype flight testing

The first Romanian prototype, White 001, made its first flight on 31 October 1974, with approval for the flight apparently coming from Nicolae Ceausescu himself. It took off at 12:08 p.m. local time on a flight that lasted 21 minutes, with Colonel Gheorghe Stanicà at the controls. The flight took place at speeds up to 500 km/h (310 mph) and heights up to 3000 m (9,840 ft). The aircraft performed several high-speed taxi tests prior to the first flight; the initial braking system caused several tyre blow-outs, and the system was later changed.

On the same day and at almost the same time, the first Yugoslav prototype, 25001, flew from Mostar. Major Vladislav Slavujevic was at the controls and this flight also lasted around 20 minutes. For their inaugural flights, both prototypes were equipped with Martin-Baker Mk 6 ejection seats provided by the Yugoslavs, and both lacked guns.

On 18 July 1975 the Romanian prototype was demonstrated to Nicolae Ceausescu at Bacau airfield. On 15 April 1975 the Yugoslav prototype was displayed on the occasion of

Colonel Gheorge Stanicä (below) performed the first IAR-93 flight, while Major Vladislav Slavujevi'c (right, standing on right) handled the Orao's maiden flight. The pilot on the left is Colonel Franc Rupnik, another well-known Orao test pilot and commander of the Yugoslav Vazduhoplovni Opitni Centar (Air Test Centre).



Romania's second prototype was an IAR-93DC two-seater. The fuselage is seen while under construction at IRAv Bacäu (above) before it was moved to Craiova for completion. The aircraft now rests in the Otopeni Aviation Museum (left).

Yugoslav Air Force Day, at Batajnica airport. It was later converted to the same standard as the first production aircraft, including the installation of guns. After the completion of its flying career, in 1988 the Yugoslav prototype was put on display at the Muzej Jugoslovensko Vazduho-plovstva (Yugoslav Aeronautical Museum) at Surcin near Belgrade, being towed there by road.

Move to Craiova

From 1975 the Romanian programme was moved from IRAv Bacäu to lAv Craiova, which was founded on 7 April 1972 specially for the series production of these aircraft. In 1974, the CI2 (Centrul de Incercàri in Zbor - Flight Test Centre) was established in Craiova for extensive testing of all Romanian-built aircraft, particularly the IAR-93 and later the IAR-99. On 21 December 1975 prototype 001 was moved to Craiova in a ferry flight.

Before lAv Craiova started to work at full capacity, six forward fuselage sections were built by IRAv in Bacäu. IRMA in Bucharest produced two central fuselage sections.

The first two-seat Romanian prototype, IAR-93DC *(dubla comanda* = dual controls) White 002, made its maiden flight on 29 January *1977.* Its construction began in Bacau but was completed in Craiova. This aircraft is now preserved at the Muzeul Aviatiei (Aviation Museum) in Bucharest, near Otopeni international airport. The Yugoslav two-seat prototype, 25002, made its first flight in November 1976 from Batajnica airfield with Major Vladislav Slavujevic at the controls.

IAR-93DC No. 003 was a pre-production two-seater that made the first flight on 4 July 1977; it was lost on 24 November 1977 during its 15th test flight, intended to determine the maximum level speed at 900 m (1,984 ft). Tail flutter caused the left stabiliser to break at a speed of 1045 km/h (650 mph) and an altitude of 500 m (1,102 ft), and the aircraft entered an uncontrollable spin. The crew, Colonels Gheorghe Stanicâ and Petre Ailiesei, ejected safely. After this event, the aft fuselage structure was reinforced with a view to increasing the critical flutter speed.

Aircraft 004 was a pre-production single-seater, also named IAR-93SCH *(simplä comanda hibrid* - hybrid single-seater), that made its first flight on 31 October 1978. It was formally delivered to Regimentul 67 Vânâtoare-Bombardament (67th Fighter-Bomber Regiment) at Craiova airfield on 8 December 1978. It was lost on 20 February 1979 and its pilot, Captain Eng. Dobre Stan, was killed; this was the only

Two batches of IAR-93A pre-production aircraft were built, comprising 11 Preserie 1 aircraft (right), and 15 Preserie 2 machines (below), which introduced nose strakes and LERXes. Pre-production I AR 93As were delivered for service with Regimental 67 from 1981.

casualty of the development programme. One of the Yugoslav prototypes used for flutter tests was lost in 1980 near Mostar due to foreign object/bird ingestion.

The first deliveries

Delivery of pre-production aircraft was performed two years behind schedule. One reason for the delay was the need to reduce aircraft weight, the prototypes being about 1000 kg (2,205 lb) heavier than initial estimates.

The prototypes were built separately in each country, but all other aircraft were built as follows: lAv Craiova in Romania produced the forward fuselage, fin and auxiliary tanks for all aircraft built in both countries, and performed the general assembly for the Romanian IAR-93s. In Yugoslavia, the UTVA factory at Pancevo near Belgrade built the aft fuselages, ailerons and pylons, and SOKO in Mostar built the wings and rudder and performed the assembly of the Oraos.

In 1979 the first IAR-93A pre-production batch in Romania, named Preserie 1 (Présenes 1), covered 11 single-seat IAR-93As (aircraft numbers 109 to 119) and four two-seat IAR-93DCS (numbers 005 to 008). The Preserie 1 aircraft featured Romanian-built Viper 632-41 engines. Most had Martin-Baker Mk 10 ejection seats as standard, instead of the Mk 6s of the prototypes, although the two were interchangeable. The cockpit was equipped with the ASP PFD-21 gyro gunsight from the MiG-21.

On 23 August 1979 three IAR-93s (001, 002 and 005) were presented in flight during the military parade marking the national holiday of Romania. In August and September 1979, IAR-93DCS 005 and 006 were delivered to Regimentul 67, followed later by 007.

The first Romanian prototype was lost during the test programme when the aircraft, flown by Colonel Hie Botea, crashed on 20 September 1979 following an engine flame-out. The pilot ejected safely. Modifications to the combustion chamber (which were made retroactively to aircraft already delivered) prevented such events from recurring.

The IAR-93A single-seat Preserie 2 aircraft were complemented by five IAR-93DC two-seaters, an example of which is seen below carrying bombs, and above in company with an IAR-93A Preserie 2, Romanian air force service began in 1981 with Regimentul 67 Vanätoare-Bombardament at Craiova, initially with Preserie 1 aircraft. The first Preserie 2 aircraft arrived in 1982, and the unit remained the only IAR-93 operator until 1989, when Regimentul 49 began operations from lanca.

The first Yugoslav pre-series aircraft began to be produced at the end of 1977 and the first flew in 1978. The pre-production batch included 10 IJ-22 single-seaters (serial numbers 25701 to 25710) and five INJ-22 two-seaters (25001 to 25605). These aircraft were later named Orao 1. They were used for reconnaissance duties and some had no guns, the installation of which involved structural changes.

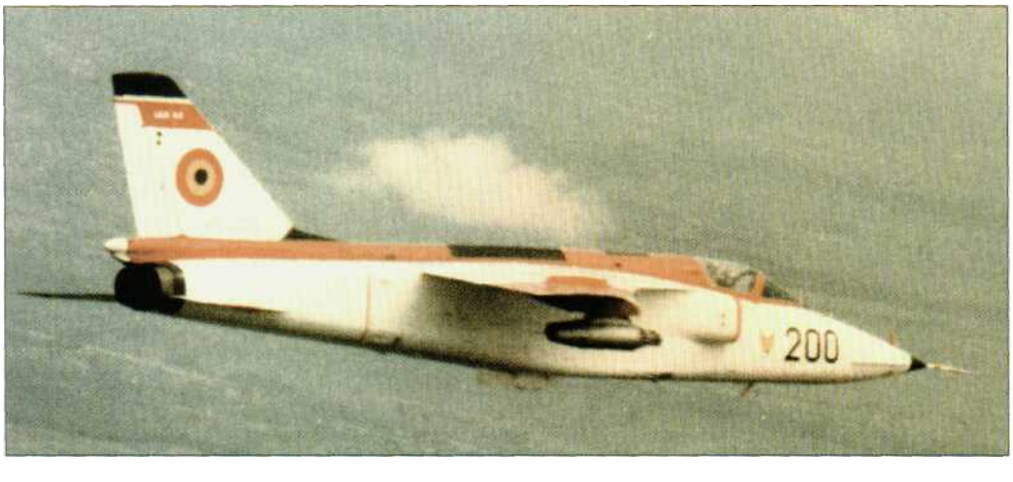
Aerodynamic refinements

IAR-93A Preserie 2 aircraft followed from 1980, and comprised 15 single-seaters (numbered 150 to 164) and five IAR-93DC two-seaters (180 to 184). The standard Preserie 2s featured strakes on the sides of the nose (their installation was required by the Yugoslavs) and wing leading-edge root extensions (although they were not present on several Preserie 2 aircraft). These aircraft also had Dowty hydraulic amplifiers replacing the Russian BU-45 (for ailerons) and BU-51M (for stabilisers) installed on early aircraft, a rudder hydraulic amplifier, Marconi artificial stability augmentation system (SAS) and autopilot, and a nosewheel steering system. Also, fuel tanks numbers 1 and 2, situated behind fuselage frame number 16, were removed on Preserie 2 aircraft.

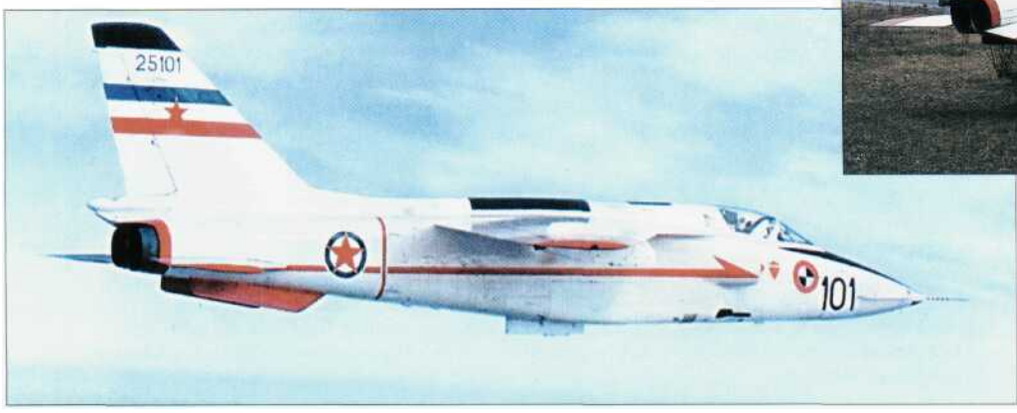
Oraos of the 241.LBAE/98.AB are seen at Petrovec airfield near Skopje, Macedonia -now a major site for NATO operations in Kosovo and Macedonia. The aircraft in the foreground with tactical code 701' was the first pre-production IJ-22 built for the JRV.

In 1980 construction began of the first production batch of Yugoslav aircraft, comprising 15 IJ-22 single-seaters (numbers 25711 to 25725) and three INJ-22 two-seaters (25606 to 25608). The aircraft differed from pre-production aircraft in the shape of the wing planform (leading-edge root extensions) and certain aerodynamic devices (strakes, fences). The first production single-seater flew in January 1981. The aircraft entered service with the JRV (Jugoslovensko Ratno Vazduhoplovstvo - Yugoslav Air Force) mainly for reconnaissance duties, along with the pre-production aircraft. The single-seat IJ-22s were declared operational in 1982, followed by the two-seat INJ-22 in 1983.

Initial deliveries to combat units were made to 353.IAE/97.AB (Avijacijska Brigada = Aviation Brigade) based at Ortjes Airbase,



Aircraft 200 ushered in a new era for the IAR-93 - it was the prototype for the IAR-93B series which featured afterburning Viper Mk 633-47 engines. The twin ventral fins, which had been found to be superfluous, were removed. The aircraft remained with the CIZ (Romanian flight test centre) throughout its career, until lost in a non-fatal crash.



25201 was the Yugoslav prototype for the afterburning Orao, becoming the first of the breed to fly supersonically (albeit in a shallow dive). The second J-22NS was displayed at the 1985 Paris air show. Unlike the Romanian IAR-93MBs, Yugoslav Orao 2s retained ventral fins.

Mostar, which was a reconnaissance unit supporting the Yugoslav Navy. Two INJ-22s were lost near Tuzla in the mid-1980s.

The second unit to receive Oraos was 351.IAE/82.AB at Cerklje Airbase, in eastern Slovenia. It also operated IJ and INJ-22 aircraft in the reconnaissance role, in support of the two attack squadrons also based at Cerklje and of the Yugoslav 5th Army in general.

One INJ-22, no. 25606, was converted at the Soko factory into a maritime surveillance version, named INJ-22M (M from *morski* = naval). The aircraft had all equipment and controls removed from the rear cockpit, replaced by a new display which included a large CRT. Under the belly was a pod housing an Ericsson Doppler surveillance radar. Several test flights were made from Ortes, near Sarajevo, in 1984. The fate of the aircraft is unknown.

Variants and production

Romania

Prototypes: one single-seater (001) and one two-seater (002)
Pre-production: one two-seater (003) and one single-seater (004), latter also known as IAR-93SCH
IAR-93A: the first production version delivered to the Romanian AF, in the form of 11 Preserie 1 machines (serialled 109 to 119) and 15 Preserie 2 (150 to 164) aircraft. The IAR-93A featured non-augmented Viper Mk 632-41 engines
IAR-93MB: airframe identical to IAR-93B, but fitted with Viper Mk 632-41 engines. Fifteen aircraft produced (201 to 215)
IAR-93B: definitive production version, featuring reheated Viper Mk 633-47 engines, leading-edge root extensions, ventral fins and no fuselage strakes. Prototype IAR-93B (200) followed by 27 production aircraft (216 to 242)
IAR-93DC: general designation applied to all IAR-93 two-seaters (IAR-93A, B or MB). Fifteen aircraft comprising 005 to 008 (Preserie 1), 180 to 184 (Preserie 2) and 600 to 605 (IAR-93MB/B)

Yugoslavia

Prototypes: one single-seater (25001) and one two-seater (25002)
Pre-production: ten single-seaters (25701 to 25710) and five two-seaters (25601 to 25605)
IJ-22 Orao 1: reconnaissance variant, single-seater, airframe similar to IAR-93A (I comes from *izvidjac* = reconnaissance). Fifteen aircraft serialled 25711 to 25725.
INJ-22 Orao 1: two-seat version of IJ-22 for pilot training in reconnaissance role. Three aircraft serialled 25606 to 25608.
J-22: (Orao 2 in the West) primary attack version, single-seater with reheat, similar to IAR-93B. New-build construction accounted for at least 43 aircraft (25101 to 25124, 25151 to 25154, and 25161 to 25175), while another eight (25201 to 25208) were probably converted from IJ-22s.
IMJ-22: (Orao 2D in the West), two-seat version of J-22 Orao 2 for pilot training in the attack role (first flight on 18 July 1986); N comes from *nastavi* = trainer. Twelve built from new (25501 to 25512) plus another six (25526 to 25531) believed to be produced by conversion from INJ-22

Enter the IAR-93B and Orao 2

In 1981, the modified design for production aircraft was completed under the leadership of Colonel Eng. Alexandru Filipescu and Colonel Eng. Milos Pétrie. The series production aircraft were to have the airframe and systems as in the initial specification, with certain aerodynamic improvements, and to be fitted with afterburning Viper engines. The first afterburner system, built in 1979, was rejected for reasons related to weight and automatic system functioning; a second system using microjet technology was certified in 1983.

On 30 April 1984, the first aircraft in the IAR-93B series, wearing registration number 200, received flight authorisation. Its configuration was that of production aircraft. It was equipped with two afterburning Viper Mk 633-47 turbojets each rated at 4,000 lb (17.79 kN) dry and. 5,000 lb (22.24 kN) with reheat. The IAR-93B had its ventral fins removed, as they had been on IAR-93DC Preserie 2 No. 180 and on the last IAR-93A Preserie 1, No. 119. Ventral fins were removed from production aircraft because they had proved inefficient on earlier aircraft.

Aircraft No. 200 made its first flight on 12 July 1984, with Viper 633-47 turbojets carrying serial numbers R1003 and R1004. Up to 2 July 1985, it logged 30 hours and 29 minutes in 48 flights. The aircraft had provision for the installation of guns, but they were not installed when flight test instrumentation was carried inside the ammunition boxes.

Above: The first J-22NS (also designated SY-1, later simplified to J-22) was placed on display in the UTVA factory complex at Pancevo.

IAR-93B No. 200 crashed on 26 November 1996, after more than 12 years of extensive testing with CIZ. The pilot, Captain Commander Matei Constantin Bebe, ejected safely.

The first Yugoslav aircraft equipped with afterburning engines (serial number 25101), designated SY-1 or J-22NS *(naknadno sagorevanje* = afterburner), made its first flight on 20 October 1983. On 22 November 1984 test pilot Marijan Jelen broke the sound barrier with this aircraft in a 25° dive, reaching Mach 1.032. This aircraft today is displayed inside the UTVA factory at Pancevo.

Due to problems encountered in the development of the engines fitted with afterburners, delivery of production aircraft started only in 1986. The JRV adopted the simple designation of J-22 for the single-seaters, while in the West they were named J-22 (M) or Orao 2. A total of 43 J-22 single-seaters was delivered, with serials '25101 to 25124, 25151 to 25154 and 25161 to 25175.

The first NJ-22 two-seater with augmented engines flew for the first time on 18 July 1986. A total of 12 NJ-22s (named Orao 2D in the West), with serials from 25501 to 25512, entered service with the JRV, the first being delivered in 1987.

Another eight J-22s and six NJ-22s were delivered, with serials 25201 to 25208 and 25526 to 25531, respectively. Some sources indicated they were converted from early IJ-22s and INJ-22s, respectively, the conversion being possible due to almost identical airframes.

Two attack squadrons received J-22 and NJ-22 aircraft: 238.LBAFy82.AB at Cerklje and 24l.LBAFy98.AB at Petrovec Airbase, Skopje. A third attack squadron, 242.LBAE (s)/172.LAP, at Golubovci Airbase, Titograd (now Podgorica),

The 351.IAE/82.AB at Cerklje ob Krki in Slovenia was the second JRV unit to receive Oraos. The aircraft nearest the camera (tactical code '605') was the last of five pre-production INJ-22 Orao 1 trainers built. They were followed by three full production INJ-22s. Six INJ-22s were later converted to NJ-22 standard.

Specification - IAR-93 and Orao

Dimensions
Wing span: 9.30 m (30 ft 6.25 in)
Length overall, including nose pitot probe: single-seater 14 90 m (48 ft 10.6 in); two-seater 15.38 m (50 ft 5.5 in)
Height overall: 4.52 m (14 ft 10 in)
Wings area, gross: 26.00 nf (279.86 sq ft)

Weights
Empty, equipped: IAR-93A 6150 kg (13,558 lb); IAR-93B 5750 kg (12,676 lb); J-22 5500 kg (12,125 lb); IJ-22 5755 kg (12,687 lb)
Maximum take-off: IAR-93A 10326 kg (22,765 lb); IAR-93B 10900 kg (24,030 lb); J-22 11080 kg (24,427 lb); IJ-22 9500 kg (20,944 lb)

Performance (for IAR-93B normal take-off weight of 8400 kg/18,518 lb)
Maximum level speed: 586 kt (1086 km/h; 675 mph) at sea level
Maximum rate of climb: 3900 m (12,800 ft) per minute at sea level
Service ceiling: 13600 m (44,620 ft)
Take-off run: 800 m (2,625 ft)
Landing run: 1050 m (3,445 ft); 690 m (2,263 ft) with brake chute
Tactical radius: 270 nm (500 km) with one auxiliary fuel tank, hi-lo-hi
Max range: 722 nm (1337 km) in clean configuration at 9144 m (30,000 ft)
***g* limits:** +8 **0/4 2**

On 28 June 1996 a sizeable number of Oraos was handed over by the JRV to the Yugoslav Aeronautical Musuem as the result of the November 1995 Dayton Peace Accords treaty which limited Yugoslavia to 155 combat aircraft. This IN J-22 (25606) was the aircraft used to test a maritime reconnaissance configuration.

provided operational conversion/advanced training for the type.

Viper 633-47 engines were not initially available for production IAR-93Bs, so the first 15 aircraft delivered from 1982 were equipped with Viper 632-4Is and known as IAR-93MBs (MB = *motor de baza* - basic engine). Aircraft 216 to 242 were production IAR-93Bs with Viper 633-47 engines and were delivered after 1987. All aircraft from 201 onwards had the ventral fins and inboard wing fences removed, and from 216 onwards the fuselage strakes were removed.

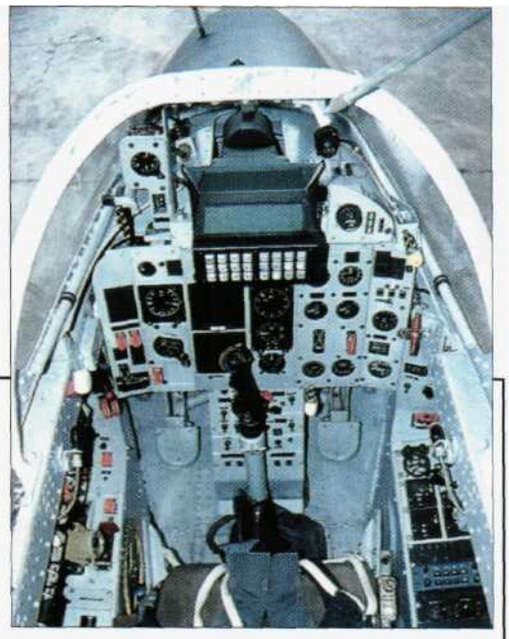
Seat testbed

A batch of six two-seaters (600 to 605) was finished and associated with the production batch of IAR-93B/MB. The first, No. 600, was assigned to CIZ and used for several purposes, such as flight testing the Romanian SC-HV-0 ejection seat, which was installed in the aft cockpit and built by Aerofina. For flight test measurement purposes, yellow scale markings were painted on the sides of the aft fuselage (horizontal) and on the fin (vertical). Other flight tests necessitated the installation of small fixed foreplanes (canards) and occurred in 1991 in three different configurations: without canards (in July), with fixed canards at 0° incidence (in October) and at 2° incidence (in November). Results indicated that the configuration at 2° incidence provided better overall performance, including better turn rates.

Aircraft No. 605 was used as a demonstrator for an upgraded IAR-93, with a Collins avionics package (identical to that installed on IAR-99 No. 712) and a 'glass' cockpit. Flight tests in this configuration started in 1992.

IAR-93 in service

In 1981 the IAR-93 entered service with Regimentul 67 Vânàtoare-Bombarciament (67th Fighter-Bomber Regiment) at Craiova airfield, with six aircraft on strength (including two-seat prototype 002) and 10 pilots certified for the type. The first sortie of a single-seat aircraft with that unit was on 14 November 1981, by Lieutenant Colonel Paul Alexandrescu. At that time, single-seat aircraft 109 to 112, as well as



Romanian testbeds

The IAR-93DC two-seater 600 was fitted with small canards (left) in place of the nose strakes to test their effect on turn performance. The aircraft was tested with the canards at 0° and 2° incidence, with the results being plotted against the aircraft flown without canards. The aircraft is seen below in the CIZ hangar at Craiova in 1992, just after the test programme.

From 1992IAR-93DC 605 (below) was used to trial an upgraded IAR-93 cockpit configuration. The front cockpit (right) featured a wide-angle head-up display and two 3-in (7.62-cm) monochrome multi-function displays.

This J 22 was assigned to the 238.LBE/82.AB at Cerklje ob Krki in Slovenia. After Slovenian forces attacked Cerklje air base with mortars during Slovenia's brief war for independence in June/July 1991, the Oraos were withdrawn but were employed on ground attack missions from bases outside Slovenia. They mainly used rockets and BL755 cluster bombs, although an attack with Durandal runway-cratering munitions against Ljubljana airport was aborted due to bad weather.

the two-seaters 005 to 008, had been delivered to Regimentul 67.

Deliveries continued in late 1981 and in the following year with the single-seat Preserie 1 aircraft 113 to 119 and Preserie 2s 150 to 154. At the end of 1982, 23 aircraft were in the inventory of Regimentul 67 and 27 pilots were flying the type. On 7 March 1983 the aircraft, led by Colonel General Fabrikov, undertook combat exercises and live bombing with 100-kg (220-lb) and 250-kg (551-lb) bombs as well as rockets and guns, firing against ground targets in front of a delegation of the Warsaw Pact countries.

On 8 March 1983, IAR-93 Preserie 1 No. 113, flown by Major Ion Táñase, crashed on landing, following pilot error; the pilot ejected safely. On 23 August 1984, a formation of 12 IAR-93s took part in the military parade.

IAR-93A Preserie 1 No. 114 is now preserved at the Muzeul Aviatiei in Otopeni, and IAR-93A Preserie 2 No. 153 is at the Muzeul Militar National (National Military Museum) in Bucharest. Unusually, No. 153 has no wing leading-edge root extensions (LERXes), which were standard features on Preserie 2 aircraft.

Up to 1987, another 24 aircraft were delivered to Regimentul 67, including IAR-93 Preserie 2 Nos 155 to 160 and 163, and IAR-93MBs Nos 201 to 205, 207, 208, and 210 to 215.

After initial preparations in 1988, in the following year 10 IAR-93s were deployed to Regimentul 49 Vânâtoare-Bombardament (49th Fighter-Bomber Regiment) at Ianca airfield, situated near the city of Brâila. They were returned to Craiova in 1990, when operations were stopped after IAR-93DC No. 601 was damaged. Between 1996 and 1997, 11 IAR-93MBs (Nos 201 to 211) and three two-seat IAR-93DC Preserie 2s (180, 182 and 183) were also assigned to Grupul 49 Vânâtoare-Bombardament at Ianca airfield; they were later replaced in active service by IAR-99s and L-39ZAs. Some of the aircraft returned to Craiova, but a number of them (202, 207, 208 and 209) remain. At Ianca AB, the IAR-93s were used as interim replacements for the retired MiG-15s.

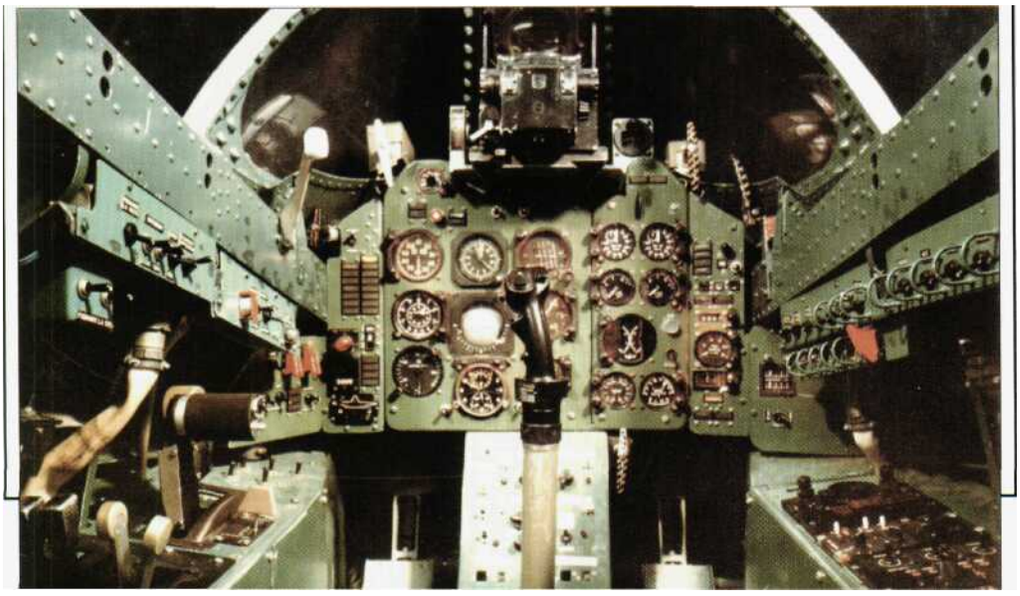
The Romanian IAR-93s never saw combat action, although between 23 and 24 December

IAR-93/Orao cockpit

Right: This 1990s vintage Orao cockpit shows noticeable differences when compared with the IAR-93 cockpits below, although the basic panel layout is similar. The primary flight instruments have a different arrangement, with the primary attitude indicator positioned higher in the Orao than in the IAR-93.

Above: This is the cockpit of an IAR-93A Preserie 1, fitted with a Martin-Baker Mk 6 ejection seat (production aircraft used the Mk 10). The gunsight is the ASP PFD-21 unit used in the MiG-21. The HSI instrument is missing from the panel.

Below: Taken with the seat removed, this photo shows the standard cockpit of the IAR-93MB. The instrument layout is entirely conventional with primary flight instruments grouped in the left-centre panel, and engine instruments to the right.



This is the SIAR-93B simulator used to train IAR-93B pilots, developed by ICSIT-Av (later Simultec). This was derived from the SIAR-93A simulator which had been developed for the earlier variant.

Preceding the definitive IAR-93B were 15 IAR-93MBs, which retained 632-41 engines and nose strakes. This example, seen at its base at Ianca, served with Regimentul 49 Vânàtoare-Bombardament. With this unit the IAR-93 briefly bridged the gap in the late 1990s between the MiG-15 and the IAR-99 Soim/L-39ZA Albatros in the attack role.

1989, during the Romanian revolution against the Communist regime, Regimentul 67 Vânàtoare-Bombardament flew 17 sorties totalling 15 hours and 18 minutes. The aircraft were scrambled each time the airspace surveillance radars indicated unidentified light aircraft flying in the area.

In 1990, IAR-93s equipped Escadrilas 1, 2 and 3 of Regimentul 67 Vânàtoare-Bombardament in Craiova, in addition to S-102s and MiG-15UTIs (replaced from 1991 by MiG-21s).

On 25 August 1992, IAR-93DC No. 602 stalled during evolution and was lost; the crew, Major Dan Cosäceanu and Captain Traían Neagoe, ejected safely. Between 1990 and 1995, the unit recorded 32 incidents with IAR-93s, half attributed to technical causes and a quarter to pilot error. On 17 October 1992, IAR-93DC Preserie 2 No. 184 with Major Ion Märculescu and Second Lieutenant Nicolae Tälpeanu started to bank after take-off due to defective installation of the aileron controls; the crew managed to land the aircraft safely.

On 1 September 1995, Grupul 67 Vânàtoare-Bombardament (67th Fighter-Bomber Group) was established at Baza Aerianä 67 (67th Airbase), Craiova, by the reorganisation of Regimentul 67 Vânàtoare-Bombardament.

In the afternoon of 9 July 1997, IAR-93MB No. 210 was loaded with the SEBAV submunitions dispenser containing live M.648 ammunition. The ammunition exploded during ground testing, killing 16 people (five from the 67th Airbase) and destroying the aircraft. On 9 April 1998, a single-seat IAR-93B from Grupul 67 crashed near the village of Ghercesti, Olt; the pilot, Commander Ion Märculescu, ejected safely. This is the last known crash of an IAR-93 before the type was grounded later that year.

Weapons

IAR-93 armament consists of two airframe-mounted 23-mm GSh-23L twin-barrelled cannon on the lower front fuselage, below the engine air intakes, with 200 rounds per gun (also installed on Yugoslav Oraos). The aircraft has five external stores stations, of which the inboard underwing pair and fuselage centreline station are plumbed for 540-litre (119-Imp gal) drop tanks and are each stressed for loads up to 500 kg (1,102 Ib). The outboard underwing stations are stressed for up to 300 kg (661 Ib) each, giving a maximum external stores load of 1500 kg (3,307 Ib) on the IAR-93A and 2500 kg (5,511 Ib) on the IAR-93B. Typical weapon loads, on single or multiple launchers, can include free-fall bombs such as the BE-50 (50 kg/110 Ib); up to 16 BE-100 or BEF-100 (100 kg/220 Ib); up to four BM-250 or BEM-250 (250 kg/551 Ib); up to five BA-500, BE-500 or BM-500 (500 kg/1,102 Ib); four LPR 57-16 (UB-16) or LPR 57-32 (LJB-32) rocket launchers each with 16 or 32 57-mm rockets; four LPR 2-122 launchers each with two PRND-122 rockets of 122-mm calibre; and a centreline GSh-23L cannon pod. Some IAR-93Bs were equipped to carry K-13 (AA-2 Atoll') air-to-air missiles on the underwing stations. The LPR-57-16 launchers can be carried in pairs on GA adapters, the 250-kg bombs can be carried in pairs on LMB 2x250 bomb racks, and the 100-kg bombs on triple (LMB 3x100) or quadruple (LMB 4x100) bomb racks.

For ground pilot training, the specialised section within ICSlT-Av (as INCREST was also known) started to build simulators for the IAR-93 (in the 1990s this facility was restructured as an independent company for the design and production of simulators, and named Simultec). The SIAR-93A2 (used for training pilots for the IAR-93A) is now displayed at the Muzeul Aviatiei. Between 1986 and 1987, SIAR-93B1 and SIAR-93B2 were built for training pilots destined for the IAR-93B.

Paint schemes and camouflage of the Romanian aircraft differed from batch to batch, but were variations of brown and yellow spots on a dark green background on the upper surfaces, with light blue on the lower surface, having the numbers painted in white with a red outline on the fuselage nose sides. Some IAR-93MBs had the numbers painted in red, outlined with white. For example, No. 200 was painted white with red wingtips, with the dorsal spine and the number in black; No. 605

An IAR-93B leads the first afterburner-equipped IAR-93DC in a flight over the Carpathian Mountains. Aircraft 600 was the testbed for the SC-HV-0 ejection seat, and the tail and rear fuselage markings were scales applied for trials purposes.

Information published in Romanian magazines revealed that an extensive upgrade was intended for the IAR-93, including the redesign of the forward fuselage for a ranging radar installation; the addition of fixed canards (as tested on aircraft No. 600); the redesign of the wingtip for the installation of a missile launch rail; and the incorporation of an integrated aircraft ladder. Further modifications were to be made to the hydraulic system (replacement of seals), and the main landing gear would be redesigned. The introduction of fly-by-wire (FEW) controls was also intended. The cockpit was to be equipped with HOTAS controls, HUD with UFCP and displays.. The avionics package would include an inertial navigation system (INS) coupled with a GPS, and VOR/ILS, DME and Radar Warning Receiver (RWR) systems were to be installed.

The final Romanian production version was the IAR-93B, which had the definitive Viper 633-47 engines installed and dispensed with the ventral fins, nose strakes and inboard wing fences. This aircraft was one of the last built, and is displayed with an array of weaponry. On the inner wing pylons are twin LPR 2-122 launchers, each holding two 122-mm (4.8-in) PRND-122 rockets. The outer wing pylons mount UB-16 rocket pods, also known as LPR 57-16 (each holding 16 57-mm rockets). On the ground are two more UB-16s, four 500-kg (1,102-lb) bombs, five 250-kg (551-lb) bombs and 12 100-kg (220-lb) bombs carried on 1MB triple racks, along with 23-mm ammunition for the two GSh-23L twin-barrelled cannon and the maximum load of 64 57-mm rockets (representing four UB-16 pods).

had a desert-type camouflage. Some IAR-93s had the tips of the nose and the tailpipe painted red, and prototype 001 had 'IAR-93' written on the air intakes. The prototype was already wearing camouflage for the first flight, with the Romanian flag on the rudder.

A total of 74 IAR-93s (all versions) was declared to be in the inventory of the Romanian Air Force. They have been grounded since 1998 and it is most likely that they will be retired soon. Around 13 are IAR-93DC two-seaters. Most served with two squadrons of Grupul 67 Vânàtoare-Bombardament based at Craiova and with the 49th Airbase lanca, and some, like No. 200 and No. 600, were used by CIZ for flighttesting.

Even before the IAR-93 was grounded, its close air support role was partially assumed by a few standard IAR-99 combat jet trainers. A total of 17 aircraft was delivered to the Romanian AF, of which 15 are still in service at the 49th and 67th Airbases.

The most important close air support asset for the Romanian AF is now the MÍG-21M/MF Lancer-A single-seater and MÍG-21UM Lancer-B two-seater, which were upgraded to close air support configuration. Fitted with modern avionics, the Lancer can use a wide range of modern weapons, including laser- and IR-guided smart bombs. The Lancer-A and -B are in service at four airbases (the 95th AB at Bacàu, 86th AB at Fetesti/Borcea, 93rd AB at Timisoara Giarmata and 71st AB at Campia Turzii).

Intentions for upgrade

In 1996, the Romanian Ministry of Defence published a document relating to long-term procurement priorities, stating the intention to upgrade its IAR-93 fleet with an undisclosed foreign partner.

Yugoslav NJ-22 two-seater Orao 20 production amounted to 12 new-build aircraft and six conversions of earlier machines. Unlike their Romanian counterparts (IAR-93B), the Orao 2s retained ventral fins.

The upgrade of the weapons system would include the introduction of laser-guided weapons, together with the installation of specialised pods (such as ECM), as well as the use of different Western and Eastern weapons (A-91, K-13, R-60 air-to air missiles, UB-32 and LPR-122 with three 122-mm rocket launchers, SEBAV sub-munitions dispensers, etc.). Another proposal was to bring the existing engines to Viper 680 standard, increasing maximum thrust by around 20 per cent.

The Yugoslavs intended similar upgrades, but, like those of Romania, they never came to fruition. Some speculative proposals were published on the internet, proposing as power-plant either the RR Viper 680 or Russian RD-35, featuring the installation of a Kopyo radar, together with the use of advanced AA missiles (R-73, R-77) and ASM (H-3D.

Service in former Yugoslavia

After the break-up of the former Yugoslavia in the early 1990s, Orao aircraft were with-drawn with the rest of the JNA (Yugoslav People's Army) units and equipment. After 1992, the Yugoslav air force became known as Ratno Vazduhoplovstvo i ProtivVazclusna Odbrana Vojske Jugoslavije (abbreviated RV i PVO, meaning Air Force and Air Defence of the Yugoslav Army). It operated several squadrons of Oraos, as follows:

• 241.LBAE (Lovacko-Bombarderska Avijacijska Eskadrila - Fighter-Bomber Aviation Squadron) 'Tigrovi' (Tigers). The J-22 was used from 1986, based at Ladjevci AB.

• 252.LBAE 'Kurjaci sa Usca' ('The Wolves From the Mouth of the River'), based at Batajnica AB near Belgrade - from 1996 to 1997 *it* used the J-22s received from the 242.LBAE in exchange for the G-4. The 242.LBAE used J-22s until 1997 when it exchanged them with 252.LBAE for G-4 trainers, based at Golubovci AB, Podgorica.

Both 241.LBAE and 252.LBAE are subordinated to 98. Lovacko-Bombarderski Avijacijski Puk (98th Fighter-Bomber Aviation Regiment).

• 353.IAE (IAE -- Izvidjacka Avijacijaska Eskadrila - Reconnaissance Aviation Squadron) 'Sokolovi' (Hawks) was the first unit to receive Oraos, in 1982. It uses IJ-22s and INJ-22s and is based at Ladjevci AB, Krajevo.

Bosnia-Herzegovina (Srspka Republic) has five to seven J-22s on strength, among them J-22 No. 25109; two NJ-22 two-seaters were lost in accidents in 1993 and 1995. The unit has been reported as the 238.LBAE/92.AB.

The Yugoslav Orao aircraft takes weapon loads similar to those of the IAR-93• All four wing stations are stressed for 500 kg (1,102 Ib) and the fuselage station for 800 kg (1,763 Ib), giving a maximum external stores capacity of 2800 kg (6,173 Ib). Typical weapon loads, placed on single or multiple carriers, can include 50-kg, 100-kg, 250-kg or 500-kg bombs; four PLAB-350 napalm bombs (each 360 kg/ 794 Ib); five BL755 bomblet dispensers; 16 BRZ-127 rockets; L-57-16MD (16 x 57-mm) or L-l 28-04 (four x 128-mm) rocket pods; five 500-kg AM-500 sea mines; two launch rails for AGM-65B Maverick or Yugoslav-developed Grom air-to-surface missiles.

All J-22 versions in use with the Yugoslav AF have a standard camouflage consisting of green and grey on upper surfaces (as on Royal Air Force aircraft) with a light blue underside. Only aircraft No. 25101 was painted overall white with red stripes on both fuselage sides.

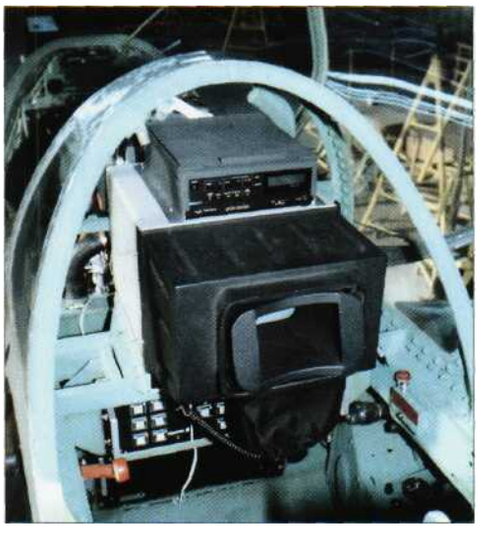
Orao in combat

The Oraos from the former Yugoslavia were heavily involved in different wars in the area, mainly on ground attack missions but also for the destruction of cruise missiles.

During the war in Croatia, only one Orao was acknowledged as being lost. On 19 September 1991 at 18.15, NJ-22 No. 25508 crashed near Ferkusevac, having been hit by a Strela 2M SAM over Dakovo. The pilot, Lieutenant Colonel Begic Muse, the commander of 172.LEAP, ejected and was taken prisoner. At least one other aircraft was destroyed on landing during the war in Bosnia-Herzegovina.

Left: A feature of the design since part way through the pre-production series are the LERXes (leading-edge root extensions), plainly visible on these \J-22s of the 353.IAE, Yugoslav air force.

INJ-22M - maritime surveillance



Above: The rear cockpit of the INJ-22M featured a large screen for the Ericsson radar display and no instruments. A large removable box and rubber hood shrouded the display.

Hitherto unknown in the West, the INJ-22M (25606) was a testbed for a maritime surveillance version of the Orao which was trialled around 1984. The most obvious feature externally was the cylindrical fairing under the fuselage which housed an Ericsson side-looking Doppler surveillance radar. The fate of the programme is unknown, although the aircraft itself was one of those 'donated' to the Aeronautical Museum as a result of the Dayton Peace Accord, albeit without the radar fairing.

Romania's supersonic ambitions

In addition to developing a modern aviation industry in the late 1960s, Romania also established a strong research and design capability, concentrated within the ICPAS design institute (known as IMFCA from 1970, INCREST from 1977, and later renamed ICSIT-Av). Facilities for advanced research were created during the 1970s, and included a Mach 3-capable wind tunnel.

The policy of the Communist leadership of Ceausescu was to create a self-sufficient aviation industry. This encompassed the production in-country of most of the components for all categories of aircraft, ranging from gliders and light aircraft, to airliners and combat aircraft. The first important achievement of INCREST was the IAR-93, designed and built in co-operation with Yugoslavia. The later IAR-99 jet trainer was the first military aircraft of entirely Romanian design.

In the late 1970s, initial studies for a supersonic fighter were begun under the leadership of Dipl. Eng. Dumitru Badea. The **IAR-95,** a high-wing monoplane, was to be equipped with a single engine, lateral air intakes and an aft fuselage section similar to that of the F-16. One of the proposed designs featured two fins.

The proposed powerplant was the military version of the Rolls-Royce Spey. The intention was to obtain the engines from the People's Republic of China, to which a production licence was granted by Rolls-Royce in 1975, under the local designation WS-9. However, the intended production rate of WS-9s was not achieved (only four engines were completed between 1976 and 1980) due to technical problems encountered by the Chinese. Faced with this situation, the idea to use the Spey in the IAR-95 was abandoned.

The supersonic fighter programme was restarted in the early 1980s under the leadership of Colonel Eng. Constantin Rosca using the Tumanskü R-29-300 turbojet, which was available from the USSR. The first layout of the new design was designated **IAR-101** and had a general layout similar to that of its predecessor, but with a much thicker fuselage, and four hardpoints under the wings (instead of two on the IAR-95).

The next step was the **IAR-S;** following the request of the then-General Director of INCREST, Constantin Teodorescu, several models were built and tested in the wind tunnel. They featured a single engine with a single fin, or two tails and two fins, or were single- and two-seaters. The two-seater was presented as a multi-role aircraft and had some similarities with the later Chinese Super 7 project. An attempt to establish a joint programme with Yugoslavia failed. That country began its own supersonic lightweight fighter project, the Novi Avion.

The supersonic programme was very ambitious and posed a real challenge for the Romanian aviation industry. To test its ability to produce such an aircraft, the decision was taken to build a technology demonstrator known as the **IAR-95ME** (Model Experimental) with the layout of the two-seater IAR-S.

The demonstrator had to be built by IAv Bucharest in Baneasa and a special branch of INCREST moved to new facilities created near the factory. The aircraft reached the detailed design stage and a full-scale mock-up of the future aircraft was started, but in 1988, for financial reasons, the whole programme was definitively cancelled.

This model shows the IAR-S in two-seat multi-role form. This layout formed the basis for the unbuilt IAR-95ME technology demonstrator.

IAR-95ME technical data
Length: 16.0 m (52 ft 5.75 in)
Wing span: 9.3 m (30 ft 6 in)
Height: 5.45 m (17 ft 10.5 in)
Wing area: 27.9 nf (300 sq ft)
Empty weight: 7880 kg (17,372 lb)
Maximum take-off weight: 15200 kg (33,510 lb)
Maximum weapons load: 3200 kg (7,055 lb)
Powerplant: one Tumanskii R-29-300 turbojet rated at 122 kN (27,420 lb) with afterburner

Above: This IAR-S design showed great similarity to the earlier IAR-95 configuration.

One of the more ambitious IAR-S configurations had wedge intakes for the two engines, inward-canted twin fins and an area-ruled fuselage.

According to Lieutenant Colonel Sreto Malinovich, the commanding officer of 241.LBAE, during the war against Yugoslavia that started on 24 March 1999, the 98th Fighter-Bomber Regiment provided the bulk of close air support for units of the 3rd Army. Tasks were assigned to this unit in total secrecy, for earlier experience had indicated that breaks in communication were possible and that the enemy could discover Yugoslav intentions. Orders were passed only to those who would fulfil the tasks.

Knowing the strengths of the enemy's fighters and the abilities of the Yugoslav forces to defend against them, the pilots used low-flying tactics and arrived at the target area from different directions. This proved wise, since on only one occasion did the coalition fighters succeed in being in a position to shoot the Yugoslav aircraft - too late, though, since they were in the zone controlled by Yugoslav air defence, and they left the area.

One J-22 was lost on the first night of the war upon return from a combat sortie. It

II? 1998 the Romanian IAR-93 force was grounded, its attack role having passed to the IAR-99 Soim and the Lancer-A (upgraded MiG-21). In July 2001 over 60 were in open storage at Craiova, this line-up numbering around 25. The aircraft nearest nearest the camera is the second pre-production IAR-93DC Preserie 1.

Three Yugoslav air force (RV i PVO) squadrons continued to fly Oraos at least until the Allied Force NATO operation commenced on 24 March 1999. Two operate J-22s on fighter-bomber duties while the third - the 353.IAE-US6S the older IJ-22s (illustrated) for reconnaissance. An underfuselage camera pod is carried, with windows for downward- and forward-facing cameras.

crashed into a hillside, killing the pilot, Lieutenant Colonel Zirota Djuric. Another aircraft was damaged, but was considered to be repairable.

The number of Orao aircraft that survived the war is difficult to estimate - the figures released are eight IJ-22s and two INJ-22 two-seaters, and a number of J-22s and NJ-22s.

Epilogue

During the 1980s both countries made unsuccessful attempts to export the aircraft. The second J-22 (25102), wearing the air show registration number 407, was displayed at the Paris air show in 1985. The price of a Yugoslav J-22 was around $US4 million. In 1988, the Romanians proposed the IAR-93 to Iran. Iranian pilots, who praised the aircraft's performance, flew it at Craiova. A deal was not concluded, possibly due to events that transpired at the end of 1989.

Production was intended to comprise 165 aircraft for each of the two countries. This was divided into 12 lots, the first being eight aircraft for Yugoslavia and seven for Romania (including two two-seaters for each country); the following 10 lots were to have 14 aircraft each (including two to five two-seaters); and the last to have 17 aircraft each (including three two-seaters). Unfortunately, this was never accomplished.

Following the outbreak of the war in Yugoslavia and the UN embargo, the IAR-93 programme was put on hold in Romania, with several airframes at different stages of construction. The last aircraft delivered to the Romanian AF were from the fourth and fifth lots. Unfinished Romanian airframes were kept in storage until 2000, when they were scrapped.

In the early 1990s the former INCREST was divided into several institutes. Design authority for various aircraft, including for IAR-93, went to INCAS (the National Institute for Aerospace Research 'Elie Carafoli'), which also holds the patent for the type.

Orao production ceased in 1992, when the plant at Mostar was dismantled. The last Yugoslav aircraft was delivered in February 1992. The UTVA factory at Pancevo subsequently assumed responsibility for the development and maintenance of Orao aircraft.

Three decades after its inception, the aircraft is in the twilight of its career. The IAR-93 is grounded and awaiting official retirement. The Orao is still in service, but in small numbers in countries that were heavily affected by the wars of the last decade. The aircraft represented an important step in the development of the aviation industries and of the air forces of Romania and Yugoslavia, and although it still had potential, it fell victim to political events in the area.

Danut Vlad

This J-22 is one of those probably converted from IJ-22 standard. It is surrounded by some of the weaponry available (including rocket pods, BL755 cluster bombs and indigenous FAB-100/-250 bombs) and carries an AGM-65 Maverick under the outer wing pylon. Other weapons associated with the Orao are the Durandal anti-runway munition and the Grom (AS-7 'Kerry' version).